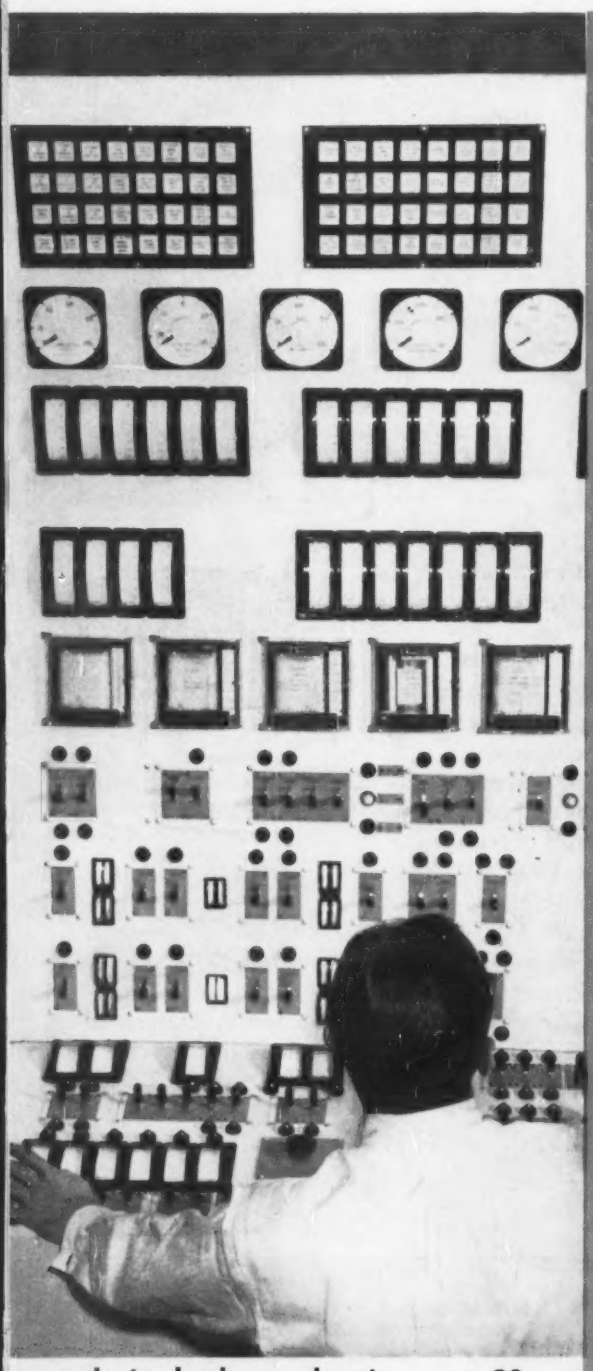
For the plant engineer . . .

12 ELECTRICAL TIPS THAT PAY OFF • 126

Power

JANUARY
1956 • 50¢

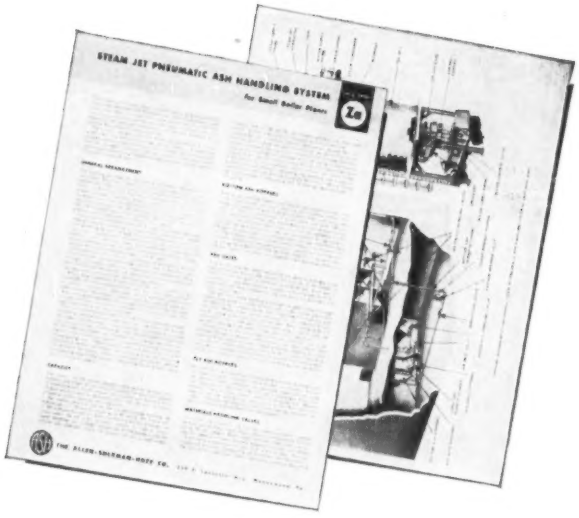
GENERATION, TRANSMISSION AND APPLICATION OF THE POWER SERVICES • A McGRAW-HILL PUBLICATION



O_2 analysis checks combustion 90

How field engineers help you 109

Ford's new electrical scheme 73



NEWS! SELF-CLEARING ASH HANDLING SYSTEM

with

3

exclusive

features!

What the jet plane did to the ox-cart, A-S-H has done to Pneumatic Ash Handling Systems. There's no clogging—no plugging—long wear—with the new Ceramic Throat, Improved Vacuum Breakers, Materials Handling Valves and other important features.

Completely new Ceramic Throated Steam Jet wears far longer than jets made of conventional materials—assures continued high efficiency with minimum steam consumption.

Newly designed, self-feeding Materials Handling Valves feed continuously into the system commensurate with the rate of air flow. There's no overfeeding or plugging of system.

Automatically operated Vacuum Breaker Valves assure a clean sweep of all risers in each dump cycle.

A-S-H Steam Jet Ash Handling Systems bring to the small boiler plant pneumatic ash handling at its best. Every A-S-H system is the product of long engineering experience, precise and practical design, skillful workmanship. For complete technical data on A-S-H Steam Jet Pneumatic Ash Handling Systems, send to Dept. A2 for Data Sheet Za.

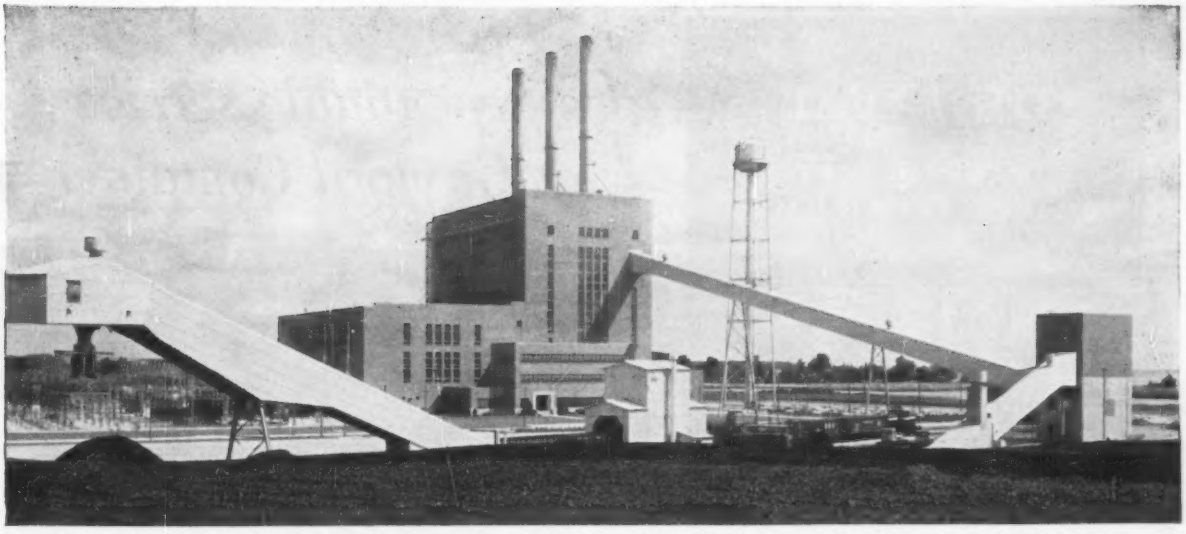
The **Allen-Sherman-Hoff** Company

259 E. LANCASTER AVE., WYNNEWOOD, PA.

Offices and Representatives in Principal Cities

MATERIALS HANDLING SYSTEMS

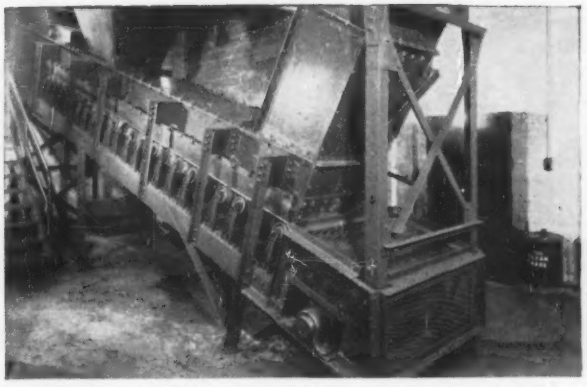
hydrojet *hydraulic* / **hydrovac** *pneumatic*



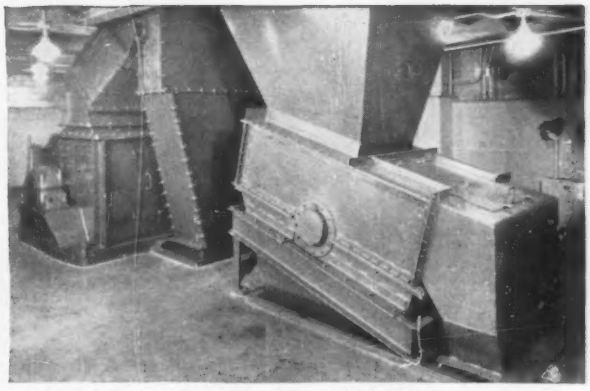
Justin R. Whiting Station uses 810,000 tons of coal per year, delivered to and from storage and to bunkers by Link-Belt conveyors.

An example of foresight . . . for power plants

building today–anticipating tomorrow



Impact troughing idlers protect belts at loading points. Enclosed transfers vented to dust-collecting systems for cleanliness.



Magnetic head pulley over crusher in background removes magnetic scrap, which is processed by Link-Belt vibrating screen.

Flexible LINK-BELT coal handling system is easily expanded . . . offers outstanding simplicity, cleanliness

CONSUMERS POWER CO.'s modern power plants are built to meet today's needs . . . with flexibility for adding facilities with minimum changeover as population growth dictates. In planning their 325,000-kw Justin R. Whiting Station, Erie, Mich., this utility realized that residential and industrial growth would require generating capacity to be doubled within ten years. And their coal handling system—furnished by Link-Belt—is ready to keep pace, with conveyors that can be speeded up and extended as proposed generating units are added.

Whatever your plant or boiler house requires in coal handling or power transmission equipment, Link-Belt will work with your own engineers and consultants in supplying it. From a complete line of equipment and unexcelled engineering background, you'll get a system that keeps your handling costs at a minimum.

Get complete facts from your nearest Link-Belt office. And be sure to ask for Book 2410 . . . illustrating examples of Link-Belt systems of all sizes.

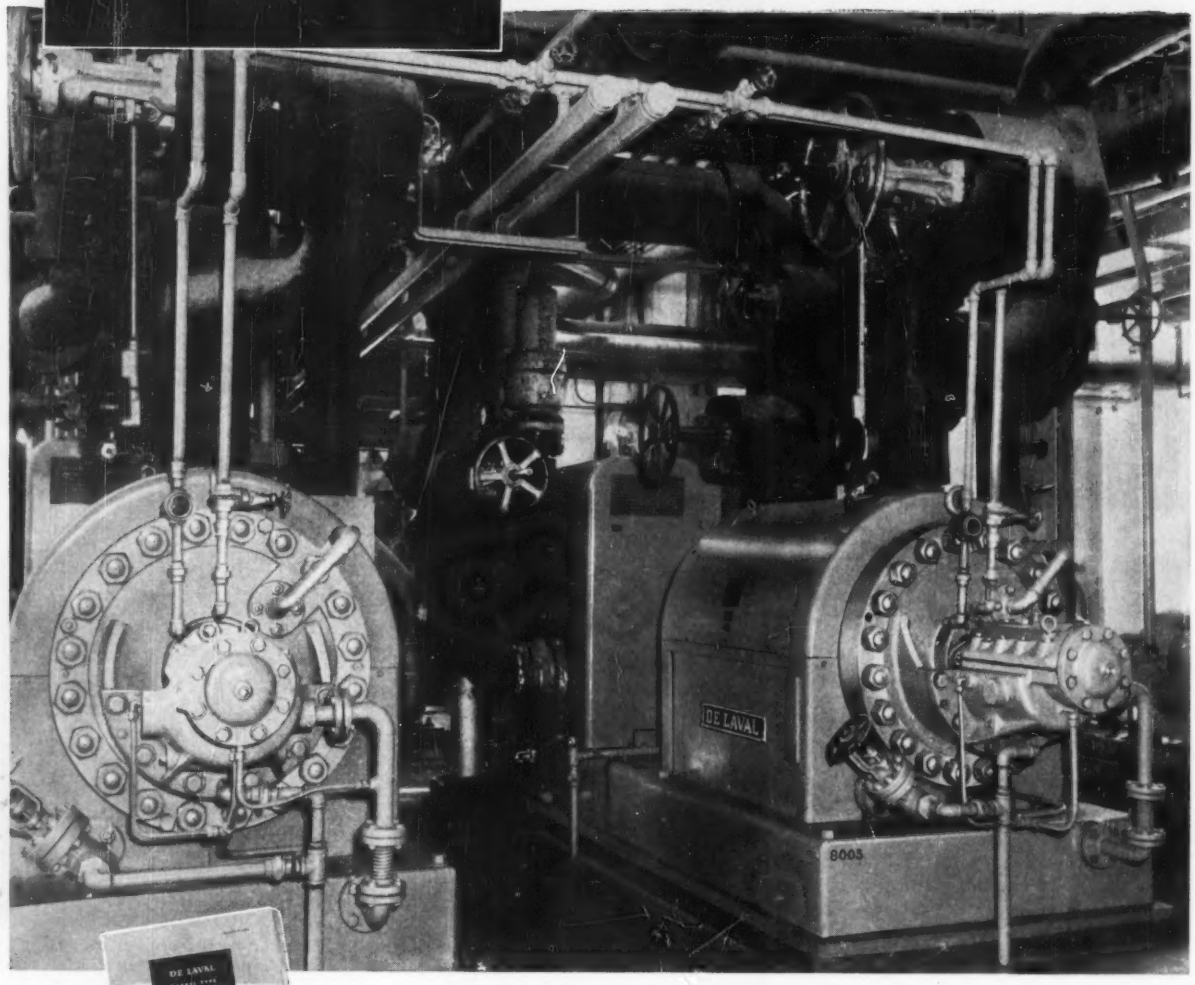
LINK-BELT

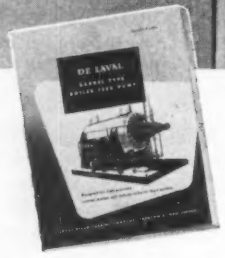
COAL HANDLING EQUIPMENT

LINK-BELT COMPANY: Executive Offices, 307 N. Michigan Ave., Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World. 13,921

DE LAVAL
BARREL TYPE BOILER FEED PUMPS

give dependable service at Gaylord Container





Bulletin contains helpful data

Bulletin 1506 on the De Laval barrel type boiler feed pump covers all major design points... has cross-section cutaway illustration for easy reference. Write for your copy.

Here's additional proof of De Laval reliability on the line in the Bogalusa, La. plant of the Gaylord Container Corporation. These two De Laval barrel type boiler feed pumps are both driven by De Laval MCP turbines operating at 850 psi, with steam temperature at 825 F.

• De Laval barrel type boiler feed pumps are widely used by industrial plants and public utilities. They operate at pressures up to 5,500 psi. These units offer many important design advantages, such as double volute diaphragm, individual diaphragm bolting, positive sealing between suction and discharge chamber and bare shaft construction. Their dependability is proven by year-in, year-out service.

DE LAVAL *Boiler Feed Pumps*

DE LAVAL STEAM TURBINE COMPANY

815 Nottingham Way, Trenton 2, New Jersey

DL 328

Power

JANUARY 1956 • VOLUME 100 NUMBER 1

ENGINEERING AND MANAGEMENT

Ford mass-production know-how aids in plant electrical design — 73
Handy chart sizes your steam piping fast — 78
Centralized control of 60,000-hp gas-turbine plant — 80
Nuclear notes: News of latest developments — 83
Astoria's No. 3 main turbine drives feed pump — 84
Today's thinking on formation of extreme-pressure lube films — 86
How load changes affect closed feed cycles — 88
Oxygen analysis for combustion control — 90
Boiler start-up, operation and shutdown — 98
Auxiliary systems for nuclear reactors: Study course — 100
Hydraulic Institute issues latest Standards — 104
Data sheet: Conduit sizing for different wire sizes, insulation — 105

PLANT OPERATION AND MAINTENANCE

Field service engineer is your best friend — 109
Power-pump maintenance — 112
Today you see through metal with a portable atomic camera — 116
Do you know your diesel-fuel specifications? — 118
Turbocharger maintenance — 118
What we learned from two floods — 120
Need portable power? Here's a low-cost high-capacity steam unit — 122
How to install and maintain thermostatic expansion valves — 124
Twelve electrical tips that paid off — 126
Practical ideas — 130
Plant problems — 136
Arguments — 142
How-to — 144
Fluid facts: No. 5 in a series — 146
Marmaduke Surfaceblow — 148

READER SERVICE SECTION

This month's service features — 152
Reports from the field — 154
Technical briefs — 156
Plant equipment news — 160
New free bulletins — 169
George Edwards — 172

Print order this issue: 47,536

A MILLION-LB BOILER is controlled from the 4-ft BTG (boiler, turbine, generator) panel shown, *left*, on this month's cover. This truly modern control point, designed by Ebasco and built by Hays Corp, is for third unit at Louisiana Power and Light's Ninemile Point plant.

Oxygen-analysis recorders are an important panel feature. For a roundup on oxygen-analysis technique and how it's shaping up as true index of combustion, see p 90.

Next month . . .

F-R turbine lube is getting a real trial, with Commonwealth Edison making first use of the phosphate-ester fluid in an operating steam turbine-generator.

St. Lawrence Project, where 33-billion kwhr can eventually be generated, is theme of upcoming hydro article as the big $600-million job goes into high gear.

Refrigeration nomograms in February issue are shaping up as true working guides for estimating power consumption, volumetric efficiency, piston displacement, compressor capacity: Two data-packed pages for fast reference.

Water supply is theme of Don Swift's latest in his popular series on organizing a new plant. Don discusses water sources, quantities, storage. Look for it!

. . . and future months

Mechanical Seals, subject of Steve Elonka's next practical manual, is slated for March. It stacks up nicely alongside Steve's reports on *Piston Rings, Gaskets, Packing.*

January 1956 POWER Vol 100—No. 1

POWER (with which are consolidated *Science and Industry, The Engineer Review, The Engineer, The Stationary Engineer* and *Operating Engineer*) is published monthly with an additional Handbook statistical number in September, by McGraw-Hill Publishing Company, Inc, James H McGraw (1860-1948), Founder. PUBLICATION OFFICE: McGRAW-HILL BUILDING, 330 W. 42nd St., New York 36, N. Y.

EXECUTIVE, EDITORIAL and ADVERTISING OFFICES: 330 W. 42nd St., New York 36, N. Y. Donald C McGraw, President; Paul Montgomery, Executive Vice-President; Joseph A Gerardi, Vice-President and Treasurer; John J Cooke, Secretary; Nelson Bond, Executive Vice-President, Publications Division; Ralph B Smith, Vice-President and Editorial Director; Joseph H Allen, Vice-President and Director of Advertising; J E Blackburn Jr, Vice-President and Director of Circulation.

SUBSCRIPTIONS: Address correspondence to POWER, Subscription Service, 330 W. 42nd St., New York 36, N. Y. Allow one month for change of address. Subscriptions are solicited only from executives, engineers and supervisory personnel engaged in design, operation and maintenance of power, light, heat and other plant services in utilities, construction firms, industrial and service plants. Position and company connection must be indicated on subscription orders.

Single copies: U. S. and possessions, Canada 50¢ (except mid-September Handbook $1.00); all other countries $1.50. Subscription rates—U. S. and U. S. possessions: $4.00 for one year, $6.00 for two years, $8.00 for three years. Canada: $6.00 for one year, $9.00 for two years, $12.00 for three years. All other countries: $15.00 for one year, $25.00 for two years, $30.00 for three years. Second-class mail privileges authorized at New York, N. Y. Printed in U. S. A.

Copyright 1956 by McGraw-Hill Publishing Company, Inc. All rights reserved.
POWER articles are indexed in both the *Industrial Arts Index* and the *Engineering Index*. POWER publishes its own annual index.

DUKE POWER Company turbines at Riverbend Steam Station, Mt. Holly, North Carolina. All seven turbines in this plant, with a capacity of 631,000 kw., are lubricated with *Texaco Regal Oil R&O*. In addition, four turbines, totaling 210,000 kw. capacity, at Duke's Cliffside Steam Station, Cliffside, North Carolina, and six turbines, totaling 440,000 kw. capacity, at Buck Steam Station, Spencer, North Carolina, are also 100% Texaco-lubricated.

NO SLUDGE, NO RUST, NO FOAM IN DUKE TURBINES...

THE REASON WHY: Seventeen of Duke Power Company's steam turbines — having a total capacity of more than 1,281,000 kw. — are lubricated exclusively with world-famous *Texaco Regal Oil* — the oil that, throughout its extra long service life, affords extra protection against sludge, rust and foam, assures clean turbine systems, normal bearing temperatures, instantaneous governor response.

Texaco Regal Oil R&O is made from carefully selected choice base stocks. These are specially refined, then further improved by effective additives and special processing.

There is a complete line of *Texaco Regal Oils R&O* to meet the stringent requirements of all leading turbine builders, for all types and sizes of turbines.

Let a Texaco Lubrication Engineer help you achieve greater power plant efficiency. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write:

The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO

TEXACO Regal Oils R&O

FOR ALL TURBINES

TUNE IN: TEXACO STAR THEATER starring JIMMY DURANTE on TV Sat. nights. METROPOLITAN OPERA radio broadcasts Sat. afternoons.

speaking of **Power**

Plain talk is an art . . .

that really pays off . . .

making industry's wheels . . .

run faster and smoother

Phil Swain: New coach for American industry in use of plain English

In 33 years with POWER, 20 as Chief Editor, Dr Philip W Swain pioneered in plain talk, set new standards of clear, concise writing for technical magazines. Since Sept 1954, when he became Consulting Editor, Phil has been thinking of ways to carry these idea-moving techniques into American industry. So now, while continuing to advise his old friends on POWER, Phil is stepping out as a consultant in technical writing and speaking. Here's his plan:

A client company will call him in for several days of intensive "workshop" drill. At these sessions Phil brings together their engineers who will write or speak for laymen or other engineers. He shows them, using the methods developed on POWER, how to write and speak so people will read, listen, understand and act.

Typical engineer "gobbledygook" Phil will gun for: "It is inadvisable to operate belting at excessive peripheral velocity." This mouthful becomes, "Don't run belts too fast." Swain figures the wheels of industry will turn faster, smoother when engineers learn how to transmit ideas with less static and friction. He knows teaching this trick will be fun, for Plain Talk is a hobby.

Speaking of hobbies, another of Phil's is public speaking. He plans to continue addressing major groups on such subjects as, "A Bombs, H Bombs and Atom Power," "Imagination, Key to Achievement," and "Engineers Versus the Human Race." Swain is slated to deliver 21 talks in the next few months as ASME lecturer for 1956.

But all these activities will be kept in check. At 66, Phil Swain doesn't plan to let work, even pleasant work, interfere with his many pure pleasures. So he'll keep up his sailing, his shop work, his barbershop singing—and spend three months each summer on his island off the coast of Maine.

Sailing is still Swain's top form of relaxation. In 1953, Phil and wife Edith sailed from Gothenburg to Oslo, Norway. Last summer they sailed a small boat from Stockholm to Finland and back. Then they shipped her to Boston and sailed her to Maine. Strenuous fun!

Phil Swain's address for business and personal correspondence will be his water-front home, 95 Club Road, Riverside, Conn.

L N ROWLEY *Editor*

B G A SKROTZKI *Engineering and Management*
S M ELONKA *Operation and Maintenance*
T G HICKS *Special Projects*
J J O'CONNOR *Managing Editor*
R C BELLAS *Assistant Editor*
H P KALLEN *Assistant Editor*
C F SANDERS *Assistant Editor*
A S THORNTON *Assistant Editor*
C F MARSCHALEK *Art Editor*
F A ANNETT *Contributing Editor*

P W SWAIN *Consulting Editor*

DOMESTIC NEWS BUREAU: *Atlanta, Cleveland, Detroit, Houston, San Francisco, Washington*

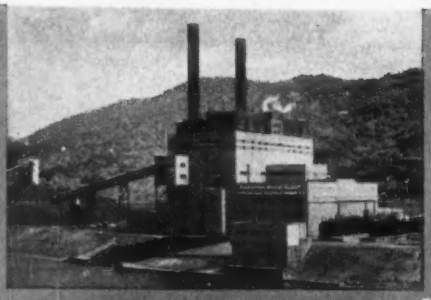
WORLD NEWS OFFICES: *London, Paris, Bonn, Tokyo, Bombay, Rio de Janeiro, Mexico City*

SHELTON FISHER *Publisher*

CLARK BOUGHTON *Sales Manager*

DISTRICT MANAGERS

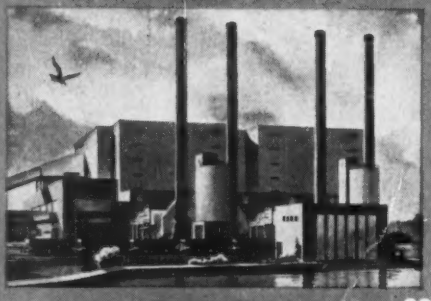
W R KLEIN, 330 W 42nd St, New York 36, N. Y.
J E DEAN, 330 W 42nd St, New York 36, N. Y.
C R LONG, Architects Bldg, Philadelphia 3, Pa.
L W ROMIGH, 520 N Michigan Ave, Chicago 11, Ill.
W K PONDER, 1510 Hanna Bldg, Cleveland 15, Ohio
R J McGURK, Continental Bldg, St. Louis 8, Mo.
S T HENRY, 801 Rhodes-Haverty Bldg, Atlanta 3, Ga.
J H CASH, First National Bank Bldg, Dallas 1, Tex.
R C ALCORN, 68 Post St, San Francisco 4, Calif.
H L KEELER, 1111 Wilshire Blvd, Los Angeles 17, Calif.



1 **KANAWHA RIVER** 9113

Appalachian Electric Power Co.
on the American Gas and Electric System

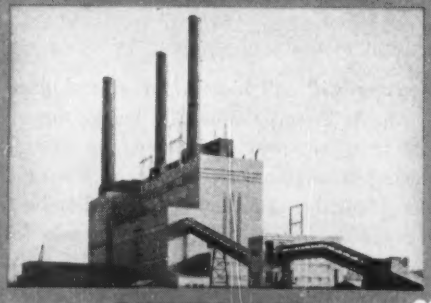
Two B&W Pressure-Fired Radiant Reheat Boilers with Gas Recirculation and Divided Furnace Construction.



2 **ST. CLAIR** 9240

Detroit Edison Co.

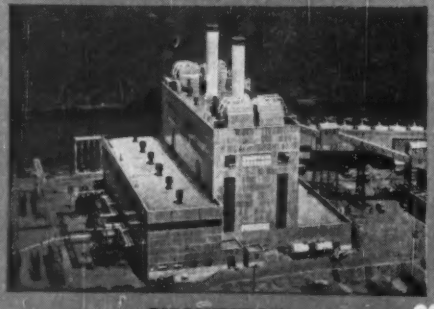
Four B&W Radiant Reheat Boilers with Gas Recirculation and Divided Furnace Construction.



3 **TANNERS CREEK** 9251

Indiana and Michigan Electric Co.
on the American Gas and Electric System

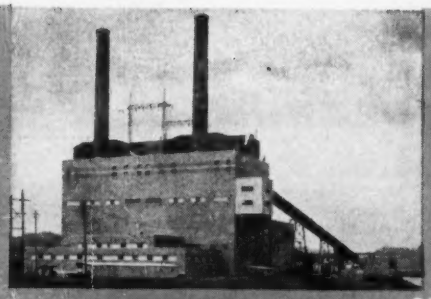
Three B&W Pressure-Fired Radiant Reheat Boilers with Gas Recirculation and Divided Furnace Construction.



4 **SHAWVILLE** 9310

Pennsylvania Electric Co.

Two B&W Radiant Reheat Boilers with Gas Recirculation and Divided Furnace Construction.



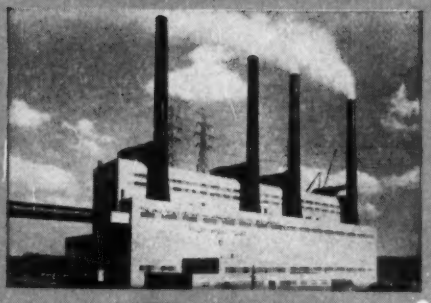
5 **MUSKINGUM RIVER** 9374

Ohio Power Co.
on the American Gas and Electric System

Two B&W Pressure-Fired Open-Pass Reheat Boilers with Gas Recirculation.

6 **EASTLAKE** 9386

The Cleveland Electric Illuminating Co.



7 **PHILIP SPORN** 9417

Appalachian Electric Power Co. and Ohio Power Co.
on the American Gas and Electric System

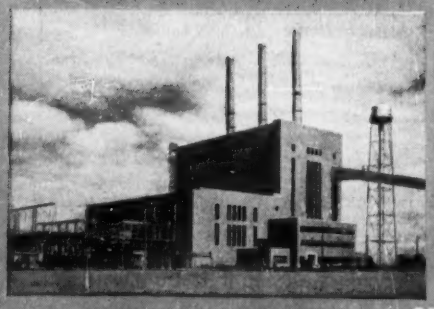
Four B&W Pressure-Fired Radiant Reheat Boilers with Gas Recirculation and Divided Furnace Construction.

8 **KEARNY B** 9556

Public Service Electric & Gas Co.

9 **BARRY** 9557

Alabama Power Co.



10 **JUSTIN R. WHITING** 9574

Consumers Power Co.

Three B&W Radiant Reheat Boilers.

10 BEST ANNUAL HEAT RATES

reflect INCREASING EFFICIENCY in power generation

Annual plant net heat rates of the ten most efficient central stations in the United States in 1954 — as reported by the Federal Power Commission — are led by Kanawha's record 9113 Btu per net kwhr. They are strong vindication of the foresighted utilization of major engineering advances which are taking this nation so far and so fast along the road of power generation progress. And the development of these advances has been possible only through the efforts of the electric companies and their primary suppliers working cooperatively to provide more electricity more efficiently.

In most of these leading stations, B&W Boilers designed with the most advanced features are contributing substantially toward achieving the remarkable plant efficiency levels reported. For example, at Kanawha the B&W vertically-fired Radiant Boiler units utilize:

PRESSURE-FIRING
To eliminate air infiltration, reduce stack loss and assure greater efficiency.

CYCLONE STEAM SEPARATORS
To assure positive natural circulation at high pressures with lowest auxiliary power cost, and send steam of highest purity to the turbines.

DIVIDED FURNACE CONSTRUCTION
To hold building volume to the minimum while achieving required furnace cooling surface.

Just behind the ten leaders are more plants — many with B&W Units — producing abundant, economical power in all parts of the country.

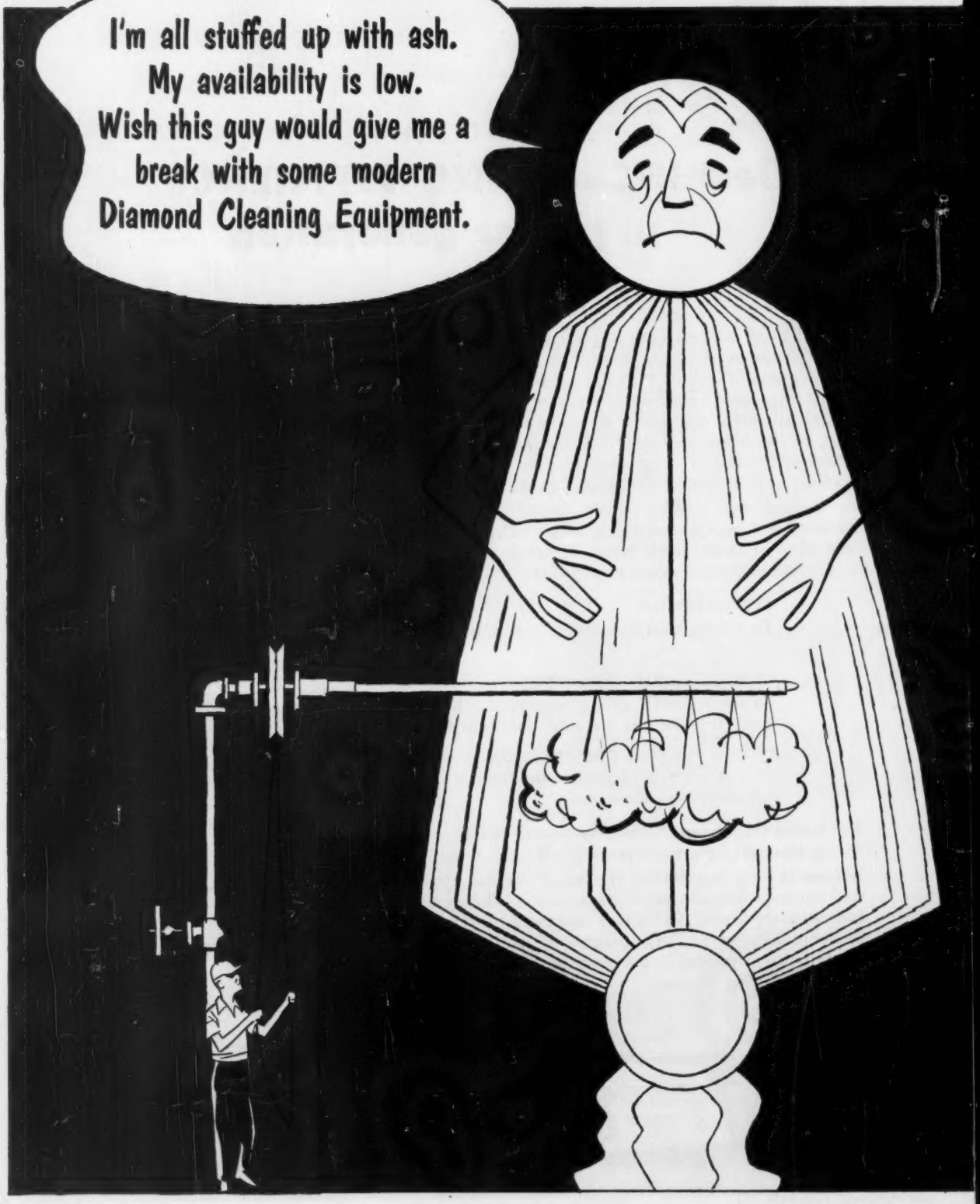
Welcoming its responsibilities as a major supplier, B&W continues to apply the knowledge derived from almost a century of boiler engineering, design and fabrication experience. And to help foresee the needs of the future, the practical results of an extensive B&W program of research and development are continuously being enlisted in the efforts to achieve still higher levels of steam-electric generating efficiency.

G-738

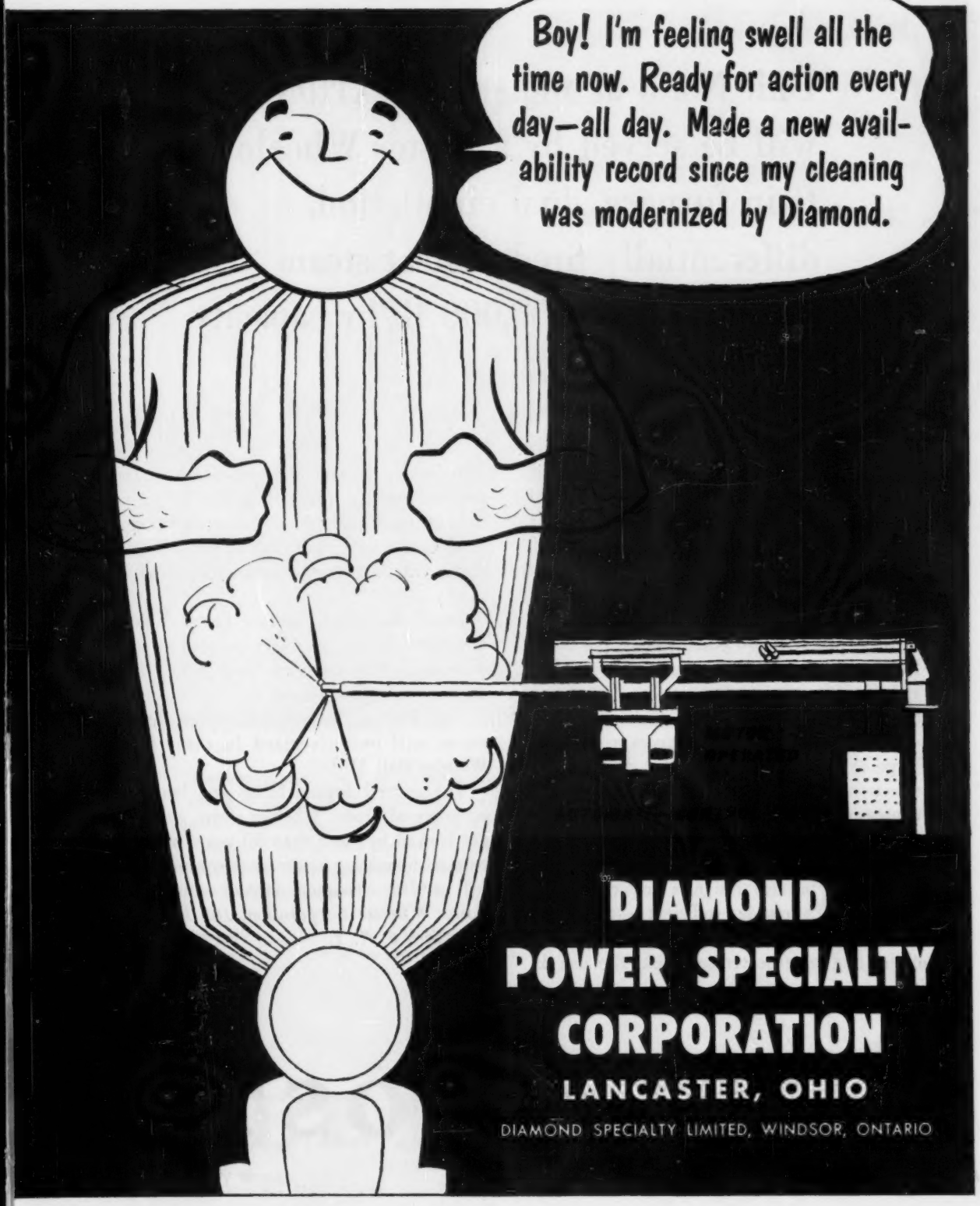
BABCOCK & WILCOX

BOILER DIVISION

Modernize Boiler Cleaning


I'm all stuffed up with ash.
My availability is low.
Wish this guy would give me a
break with some modern
Diamond Cleaning Equipment.

to IMPROVE AVAILABILITY


Boy! I'm feeling swell all the time now. Ready for action every day—all day. Made a new availability record since my cleaning was modernized by Diamond.

DIAMOND POWER SPECIALTY CORPORATION

LANCASTER, OHIO

DIAMOND SPECIALTY LIMITED, WINDSOR, ONTARIO

UNION ELECTRIC adds

Unit No. 3 at MERAMEC STATION will be served by a Foster Wheeler twin furnace, dual circulation, differentially fired, reheat steam generator of 1,850,000 lb/hr capacity

With the addition of this 275,000-kw Unit No. 3 at Meramec Station, Union Electric Company of Missouri will boost total station capacity to 560,000 kw, keeping well ahead of anticipated load growth.

The new turbine will be served by an FW steam generator with a maximum continuous capacity of 1,850,000 pounds steam per hour, 2150 psig at the superheater outlet, 1010F/1010F. This unit is unique in that it combines twin furnace arrangement, dual circulation and reheat—three major advances in modern, large capacity steam generator design. The selection of this combination is a gratifying expression of confidence in the efficiency and dependability of Foster Wheeler steam generating equipment.

The twin furnace design, a Foster Wheeler development, provides sufficient water-cooled and steam-cooled areas to prevent slagging of boiler and superheater surfaces. The use of combination radiant and convection surfaces for superheating, plus differential firing, permits constant final and reheat steam temperatures over a wide operating range, stabilizing steam conditions for maximum turbine efficiency.

Dual circulation, another Foster Wheeler development, has been incorporated as insurance against potentially troublesome silica deposition in the turbine.

Coal for the differential-fire-controlled furnaces will be pulverized in three Foster Wheeler Ball Mills.

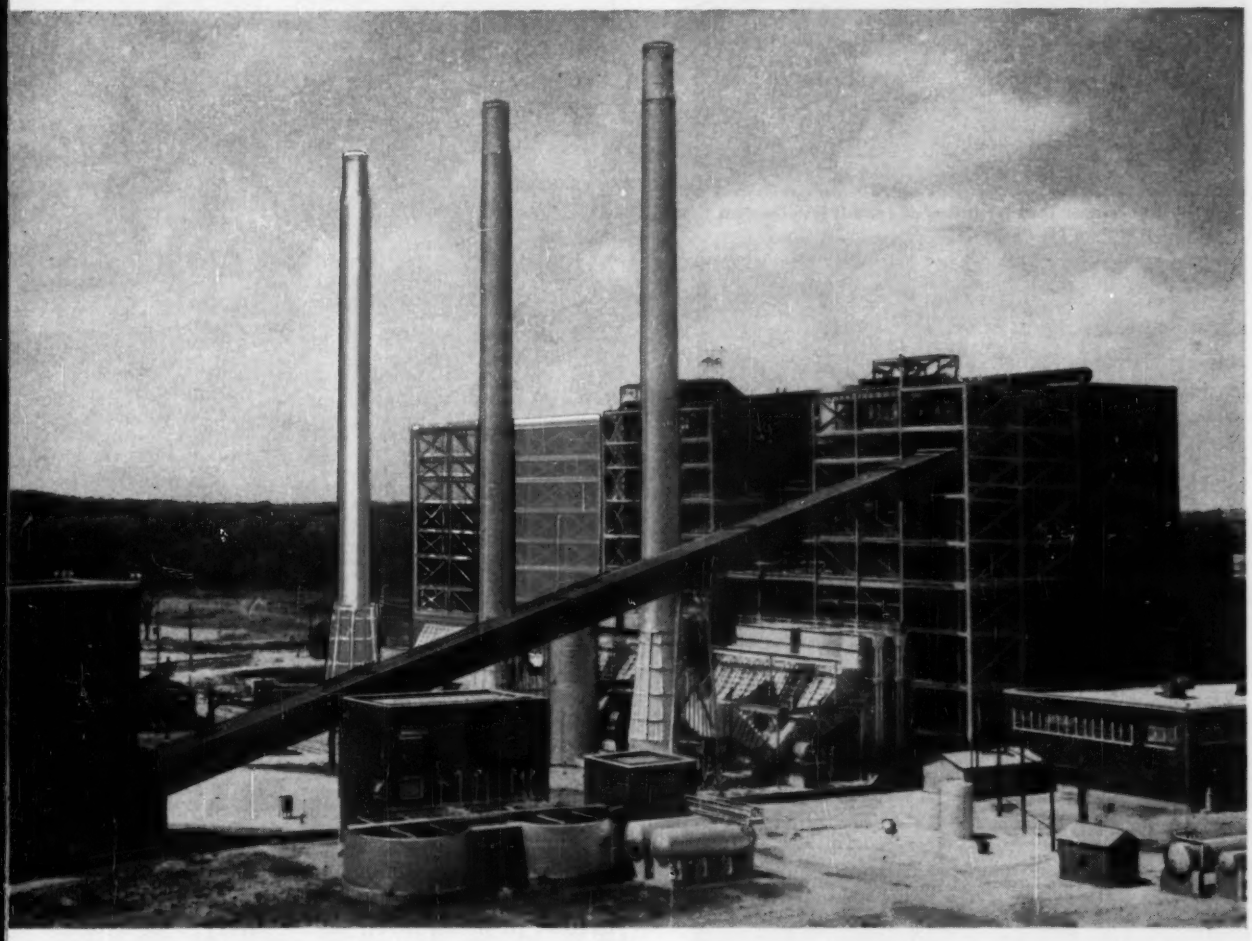
The proved dependability and long-range economy of Foster Wheeler steam generators are backed by more than 50 years of experience in pioneering power plant equipment. We will be pleased to quote on your requirements. *Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.*

STEAM GENERATORS
SURFACE CONDENSERS
FEEDWATER HEATERS
HEAT EXCHANGERS

FOSTER

NEW YORK • LONDON

1,850,000 lb steam per hr!



The above photograph of Union Electric's Meramec Station shows, in color, the new Unit No. 3 as it will appear when the addition is completed in 1958. With a capacity of 275,000 kw, Unit No. 3 will increase the total output of Meramec Station to 560,000 kw. keeping system capability well ahead of maximum anticipated load growth.

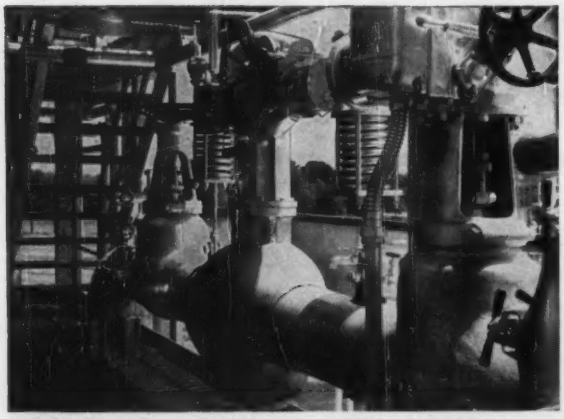
Reddy Kilowatt

** Trade mark character used by permission of Reddy Kilowatt, Inc.*

WHEELER

• PARIS • ST. CATHARINES, ONT.

ECONOMIZERS
BALL MILL PULVERIZERS
COOLING TOWERS

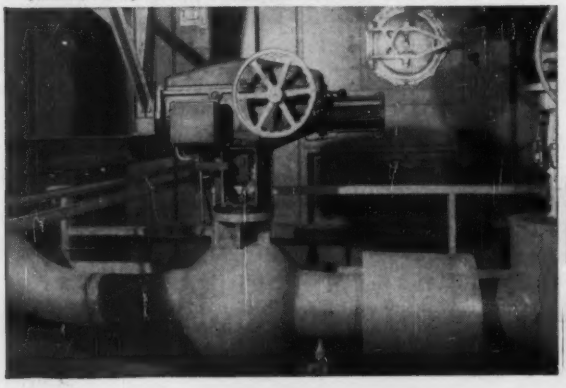


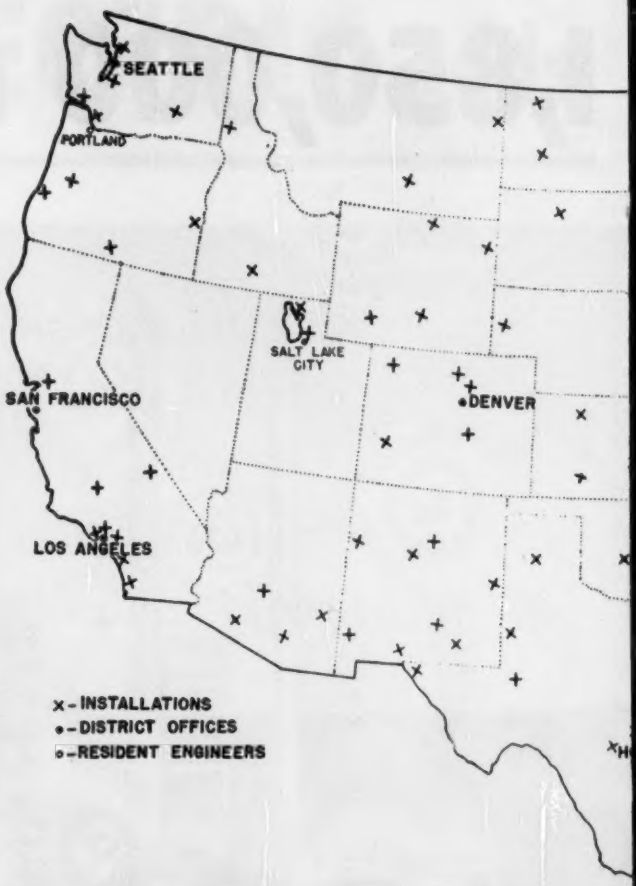
Bailey Three-element Feed Water Control Valve in feed line to a 450,000 lb per hour boiler.

Operator's station for Bailey Three-element Feed Water Control is located in this compact control room.

(Above) Bailey Boiler Control Panel for 750,000 lb per hour unit including Three-element Feed Water Control.

(Below) Bailey Control Valve in feed water line to above unit.





Here's Proof—

Bailey Is Your Best Buy in

More than 1000 large boiler units are equipped with Bailey Three-element* Feed Water Control for close regulation of drum level, added safety, and added efficiency.

That Bailey is better than a 2 to 1 favorite against the combined total of all other makes used in this service is borne out by checking the 173 steam-electric stations listed by Electrical World in its design issues of May 8, 1950 and April 7, 1952. No wonder we can say Bailey is your best buy.

Such an endorsement by users of power equipment doesn't just happen. It's the result of carefully weighing all factors: design superiority, accuracy of operation, dependability in service, and the experience of the

BAILEY METER

1036 IVANHOE ROAD

Complete Controls for

1000 times!

Feed Water Control

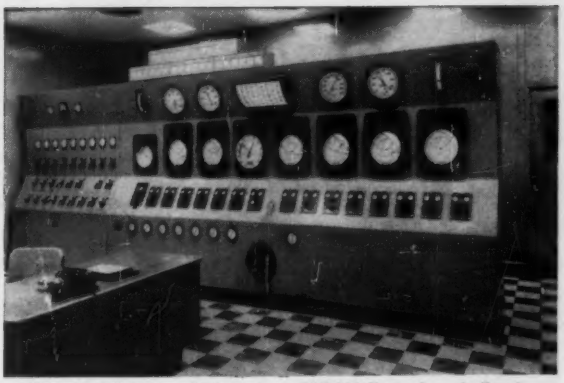
manufacturer in building and servicing this type of equipment.

That's why you should check with users before you buy. And you'll find a Bailey user near you. We couldn't spot over 1000 installations on one small map—but from those we were able to show, you can get some idea of Bailey's universal popularity—and how easy it is to get service with a minimum of travel time and expense. Call your nearest Bailey Office—they will be glad to arrange an inspection tour for you. And if you want catalog information, including a list of users, write for Bulletin 105-C Bailey Meter Company. A-123-2

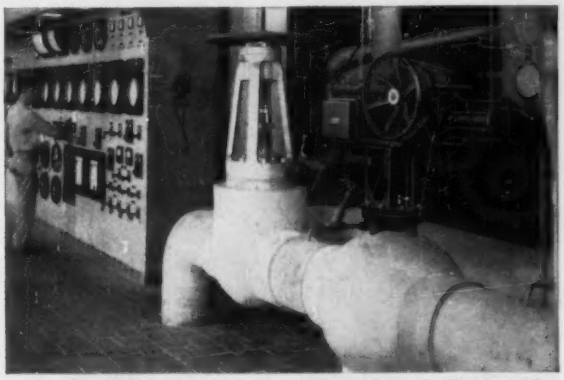
*The three elements are—1. Steam Flow from Boiler
2. Water Flow to Boiler
3. Water Level in Drum

COMPANY
CLEVELAND 10, OHIO
Steam Plants

COMBUSTION
FEED WATER
TEMPERATURE
PRESSURE
LIQUID LEVEL
FEED PUMPS



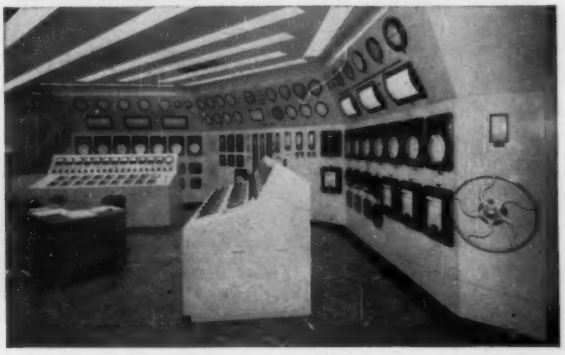
This control room, which serves a 500,000 lb per hour boiler, includes an operator's station for Bailey Three-element Feed Water Control.

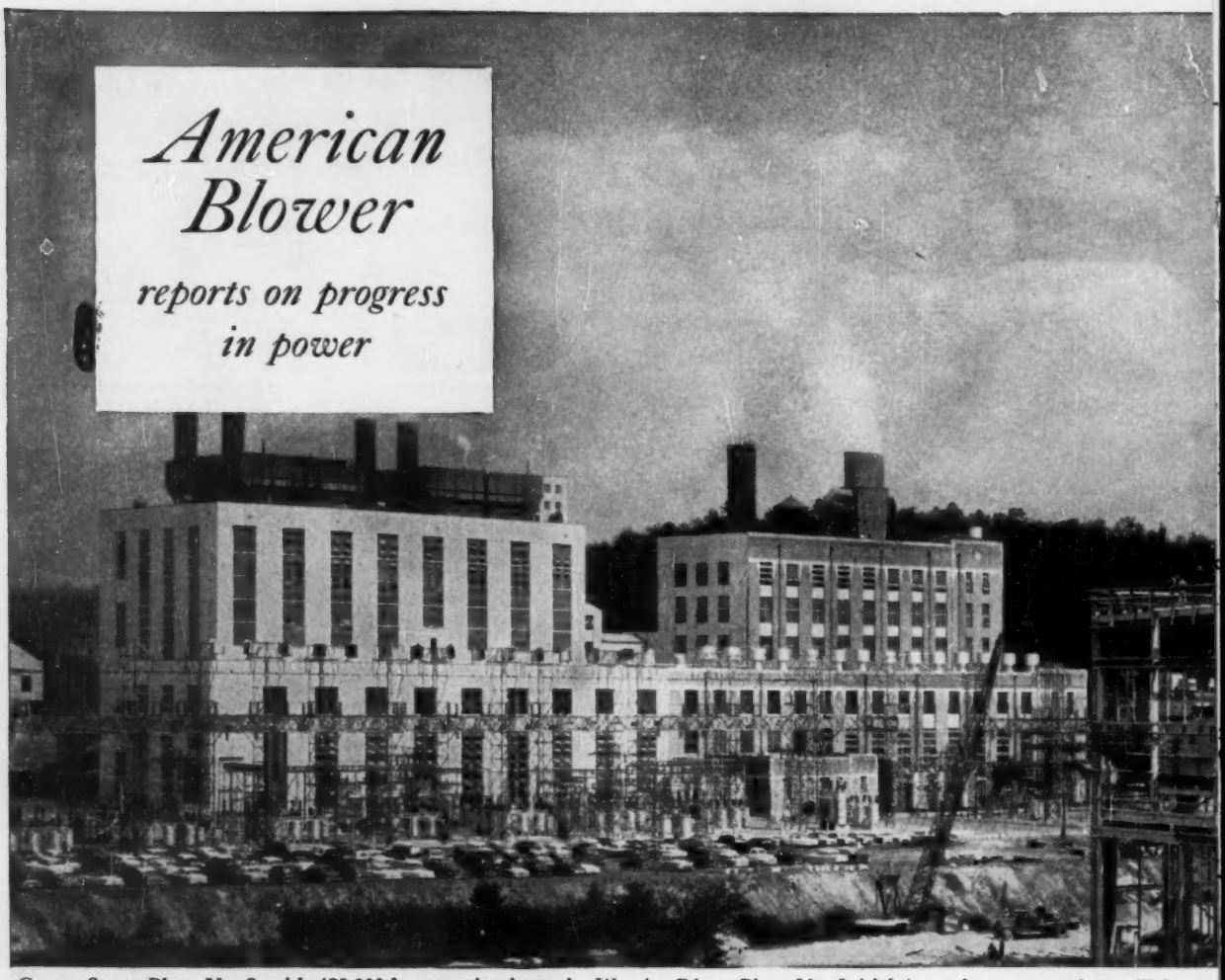


This 575,000 lb per hour Bailey Feed Valve is automatically operated by Three-element Feed Water Control.

(Above) Operators' stations for Bailey Three-element Feed Water Control are concentrated in this centralized control room for three 250,000 lb per hour boilers.

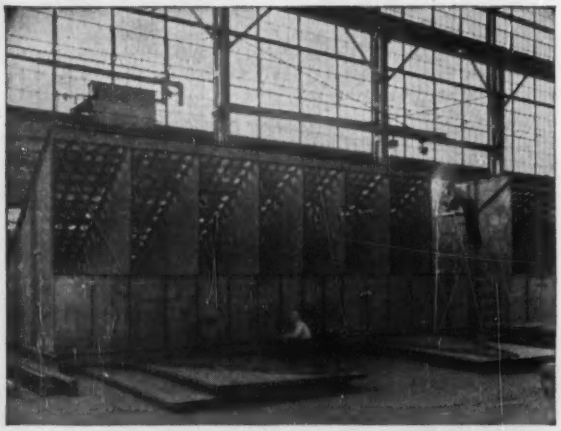
(Below) Three-element Feed Water Control is part of the complete Bailey Control System operating two 500,000 lb per hour boilers from this control room.





Gorgas Steam Plant No. 2, with 428,000 hp capacity, is on the Warrior River. Plant No. 3 (right), under construction, will house

Alabama Power ups capacity to



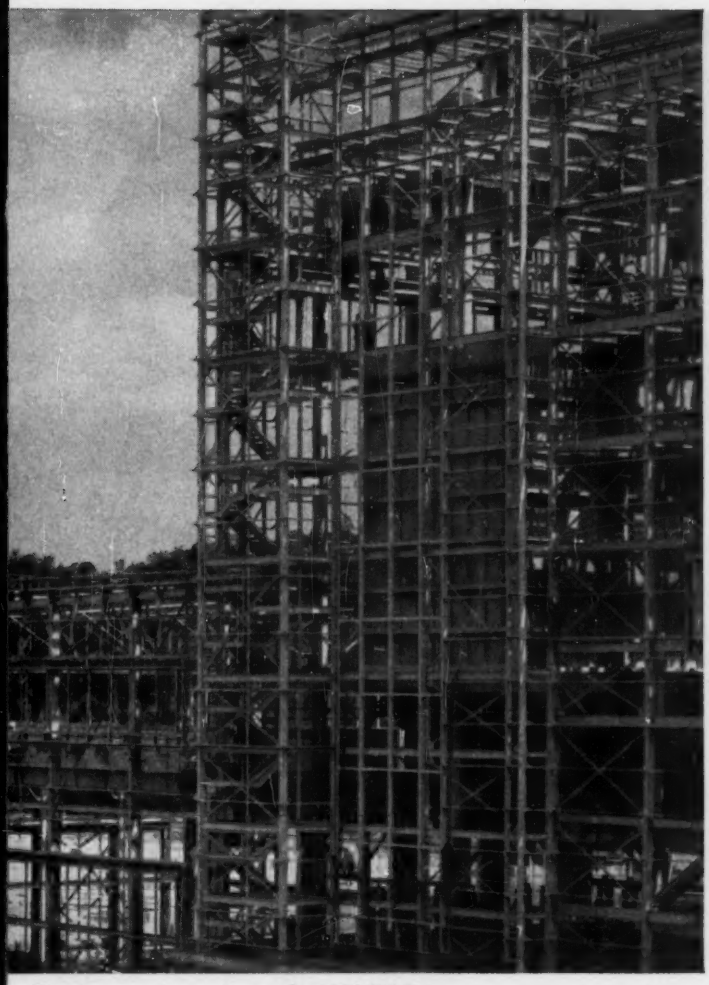
While Gorgas Steam Plant No. 3 is being built, American Blower constructs two Fly Ash Precipitators which will be installed in this new plant. Ratings: 340,000 cfm @ 285° F.

As in the past, Alabama Power installs American Blower equipment—in building for the future

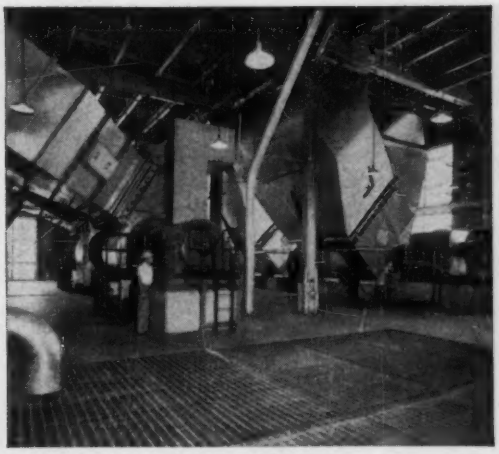
WITH six steam and six hydroelectric plants, the Alabama Power Company forges ahead for the future of Alabama. In 1955 alone, it will invest more than $35,000,000 in bigger and better electrical facilities, including an eighth generating unit at their Gorgas Steam Plants. When completed this year, Alabama Power's capacity will be over 2,000,000 hp!

American Blower Forced and Induced Draft Fans, Fly Ash Precipitators and Gyrol Fluid Drives are being installed in this new plant.

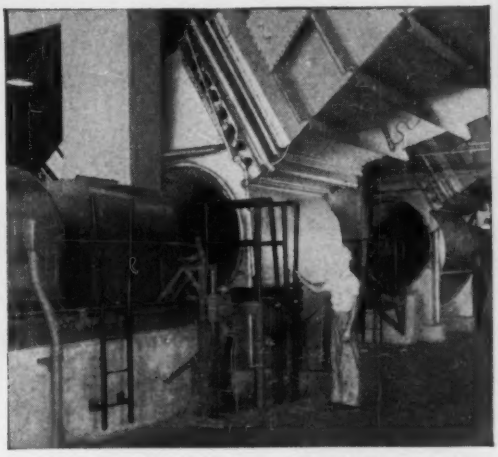
From coast to coast you'll find American Blower playing an important role in the expansion and modernization of many other progressive, investor-



No. 8 generating unit, rated at 208,000 hp.



Gorgas Unit No. 7 uses American Blower Fans with Gýrol Fluid Drives. Induced Draft Fans (above) are rated @ 262,500 cfm @ 270° F @ 15.25" sp @ 569 rpm.



American Blower Forced Draft Fans on Unit No. 7 at Alabama Power's Gorgas Steam Plant are capable of 180,000 cfm @ 140° F @ 11.00" sp @ 868 rpm.

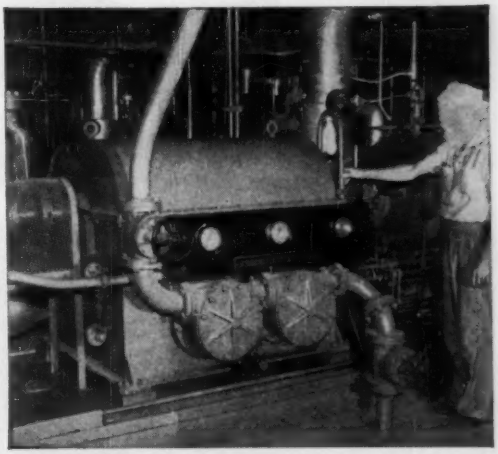
over 2,000,000 hp!

owned utilities. Plant operators have come to rely on American Blower Heavy-Duty Steam Coils and Fly Ash Precipitators, as well as our Mechanical Draft Fans, Dust Collectors, and Gýrol Fluid Drives for boiler-feed pump and fan control.

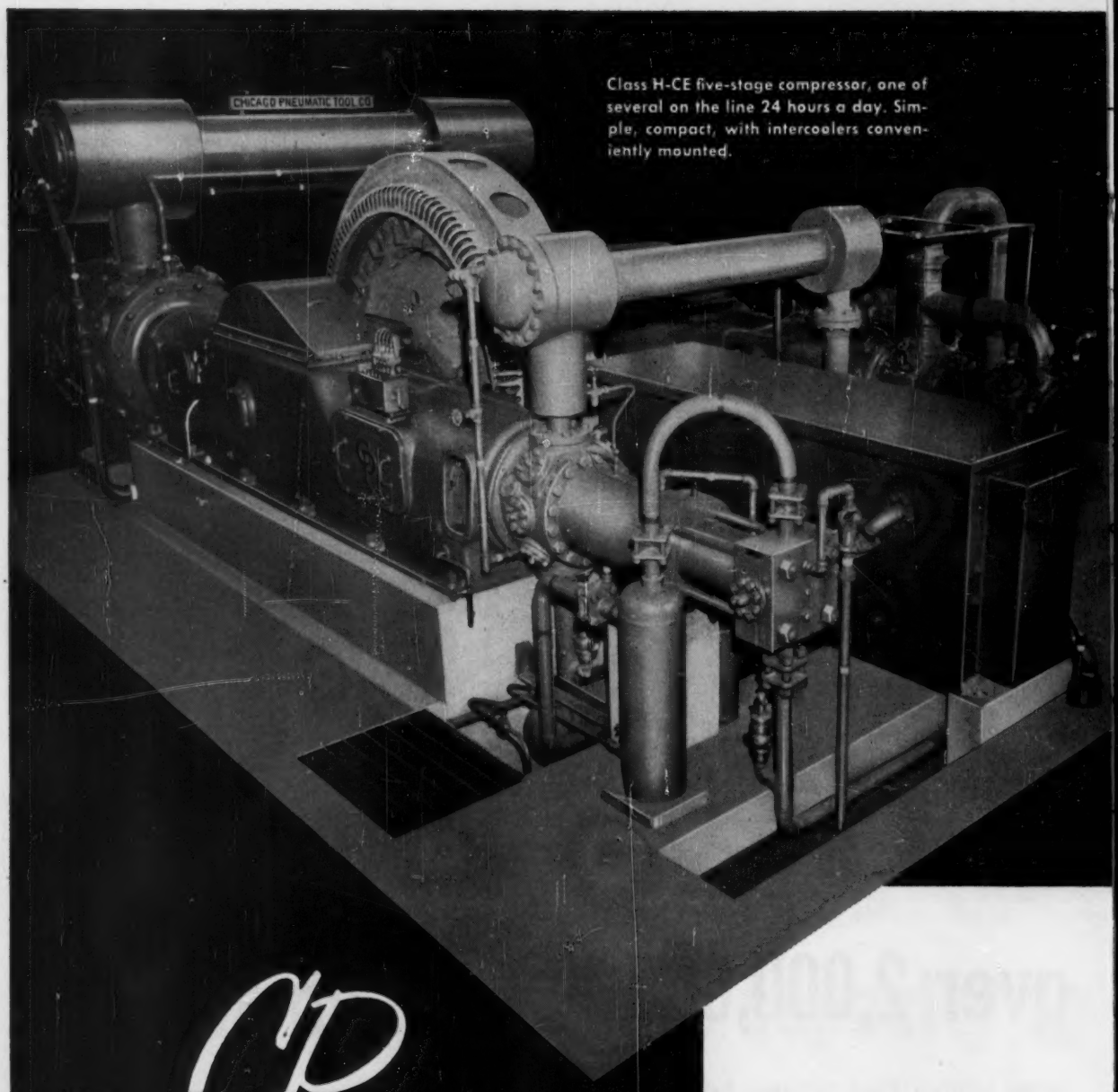
Give us a call to discuss *your* program. An experienced representative will gladly go over your requirements, and recommend equipment of the highest efficiency and economy. Contact your American Blower or Canadian Sirocco Branch Office.

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of American-Standard

AMERICAN 75th ANNIVERSARY YEAR 1881-1956 **BLOWER**



In addition to fan control, American Blower Gýrol Fluid Drives — class VI, 1500 hp — are used for adjustable speed control of boiler-feed pumps.

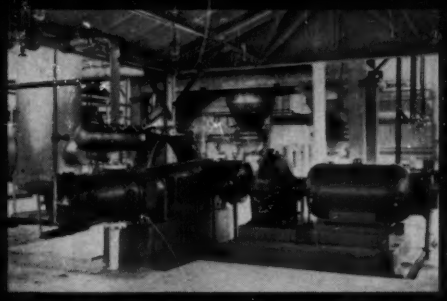


Class H-CE five-stage compressor, one of several on the line 24 hours a day. Simple, compact, with intercoolers conveniently mounted.

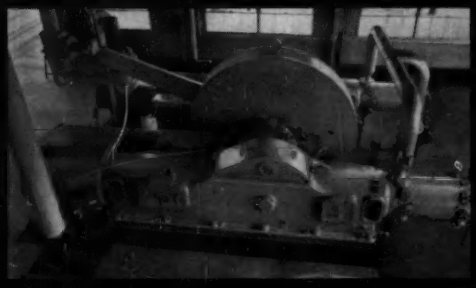
CP

COMPRESSORS—

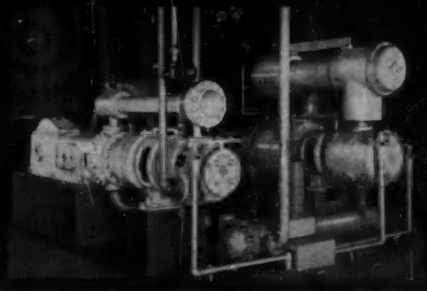
serving the process industries



Non-lubricated, hydrogen recycle compressor, with enclosed distance piece; electric motor-driven through gear reducer.



Class "H" steam-driven, single-stage booster compressor handling hydrocarbon gas.



Class O-CE four-stage, motor-driven compressor. Note simple arrangement of intercoolers.

- **FOR PRESSURES TO 15,000 PSIG**
- **SIZES TO 4000 H. P.**
- **WITH MOTOR, BELT OR STEAM DRIVE**

For process work, Chicago Pneumatic offers a complete line of electric and steam driven heavy-duty reciprocating compressors to handle most known gases.

Rugged in design and conservatively rated, they are ideal for continuous, round-the-clock duty; each engineered to specific job requirements with special materials, construction, capacity or pressure controls to suit.

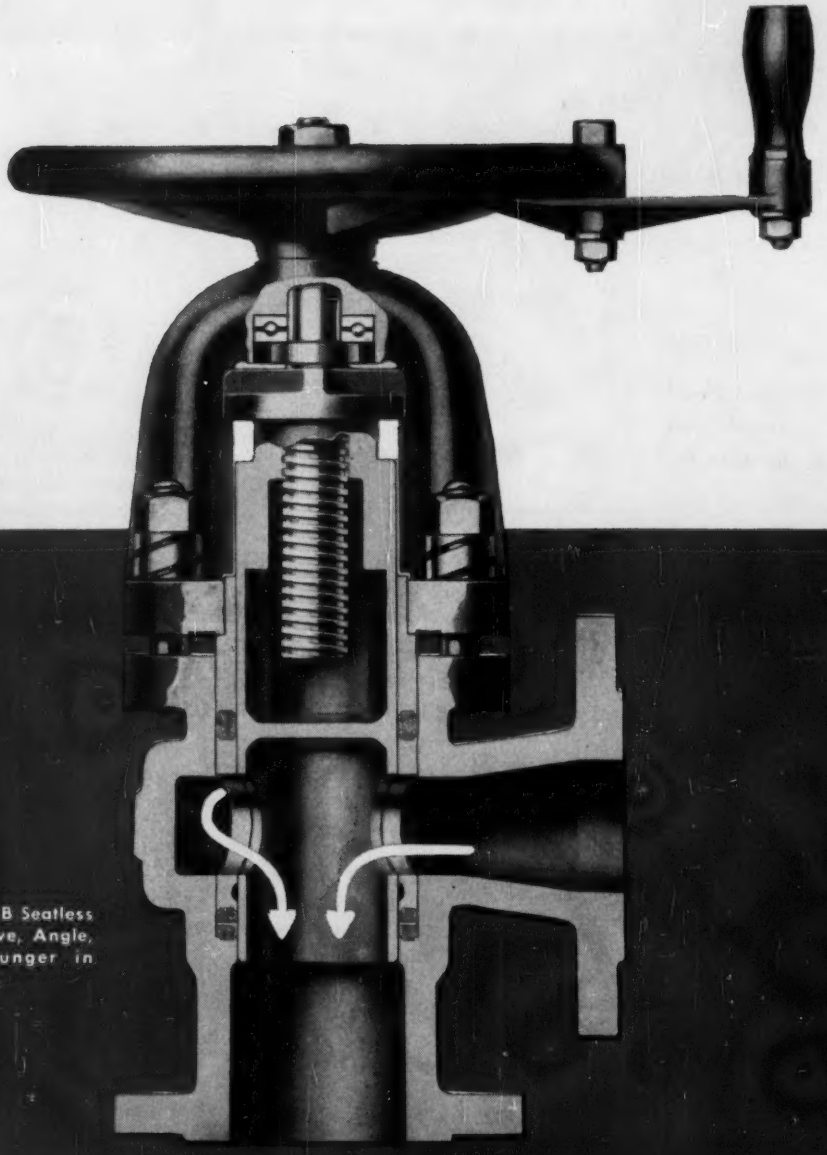
24 hours a day!

Chicago Pneumatic *8 East 44th St., New York 17, N. Y.*

PNEUMATIC TOOLS • AIR COMPRESSORS • ELECTRIC TOOLS • DIESEL ENGINES • ROCK DRILLS • HYDRAULIC TOOLS • VACUUM PUMPS • AVIATION ACCESSORIES

seatless

. . . for



Yarway Type B Seatless Blow-Off Valve, Angle, showing plunger in open position.

YARWAY

trouble-free blow-down service

YARWAY SEATLESS BLOW-OFF VALVES

"Trouble preventers" is what YARWAY Seatless Blow-Off Valves are often called because they eliminate one of the commonest sources of trouble in low and medium pressure boiler blow-down service. *There is NO SEAT to score, wear, clog or leak.*

YARWAY Seatless Blow-Off Valves feature a balanced, sliding, hollow plunger design that permits free and easy operation—full, unobstructed flow.

More than 16,000 boiler plants today use YARWAY *Blow-Off Valves.*

YARWAY Bulletin B-426 shows all the latest types and features of YARWAY Seatless Blow-Off Valves. If you operate your boilers up to 400 psi, you'll find a copy helpful. For higher pressures, ask for Bulletin B-434. Write today.

YARNALL-WARING COMPANY
100 Mermaid Ave., Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

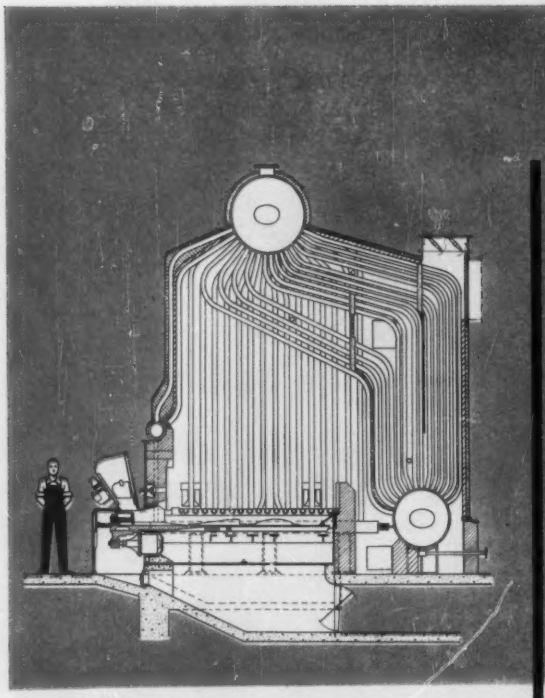
Yarway Type B Seatless Tandem Blow-Off Valve. Angle-angle combination. Pressures to 400 psi.
Yarway Type B Seatless Blow-Off Valve, Straightway. Pressures to 400 psi.
Yarway Type B Seatless Tandem Blow-Off Valve, Angle—Straightway. Pressures to 400 psi.
Yarway Type B Seatless Blow-Off Valve, Angle. Pressures to 400 psi.

blow-off valves

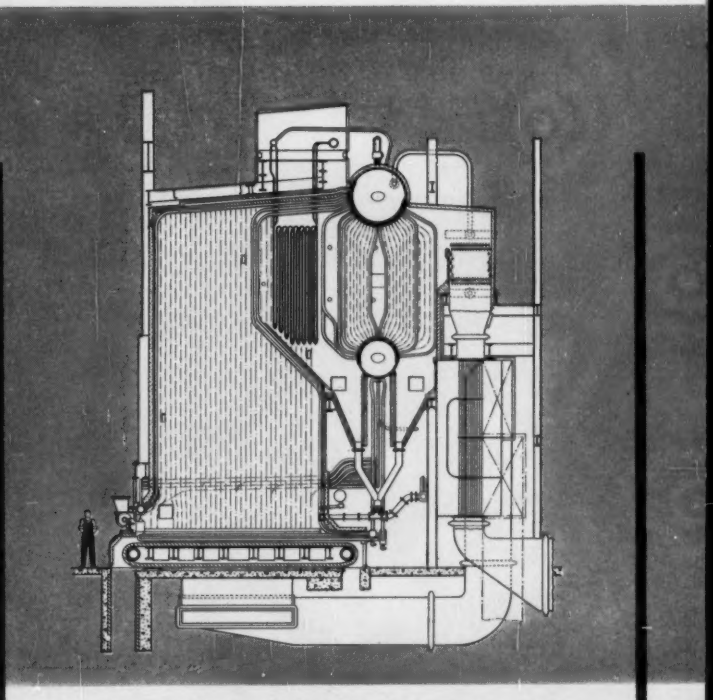
MODERN STOKER-FIRED BOILERS

Despite the relatively wide extent to which oil – and gas – have come into use for firing industrial boilers, the fact remains that coal continues to be the most economical fuel available in many areas.

Moreover many potential coal users are unaware of the tremendous improvements that have been made in recent years in the design and general effectiveness of mechanical stokers. Here at Combustion virtually the entire stoker line has had extensive design changes, all directed at improved performance. But overall performance is tied in inescapably with boiler performance. At Combustion you have the important advantage of dealing with a leading boiler manufacturer that also offers the most complete line of stokers available anywhere. You are assured, therefore, of a completely coordinated design comprising



This C-E Vertical-Unit Boiler, Type VU-10 fired by a C-E Underfeed Stoker, Type E is for a dairy. Capacity is 30,000 lb steam per hr at 150 psig. VU-10 Boilers are available for capacities from 10,000 to 60,000 lb of steam per hr. They are often equipped with C-E Spreader Stokers, dump grate type.



One of two duplicate units for a chemical company comprising C-E Vertical-Unit Boilers, Type VU-40 fired by C-E Spreader Stokers, continuous discharge type. These are baffleless boilers designed for a capacity of 150,000 lb steam per hr at 900 psig and 808 F. Coal is Eastern Bituminous.

COMBUSTION

Combustion Engineering Building, 200 Madison Avenue, New York 16, N. Y.

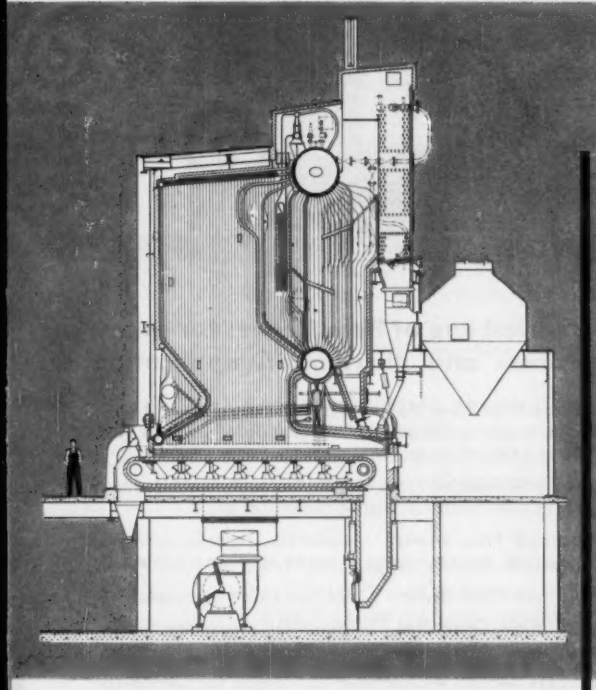
STEAM GENERATING UNITS; NUCLEAR REACTORS; PAPER MILL EQUIPMENT; PULVERIZERS;

stoker, boiler, furnace and – if desired – heat recovery equipment and/or auxiliaries, all engineered specifically for your particular requirements.

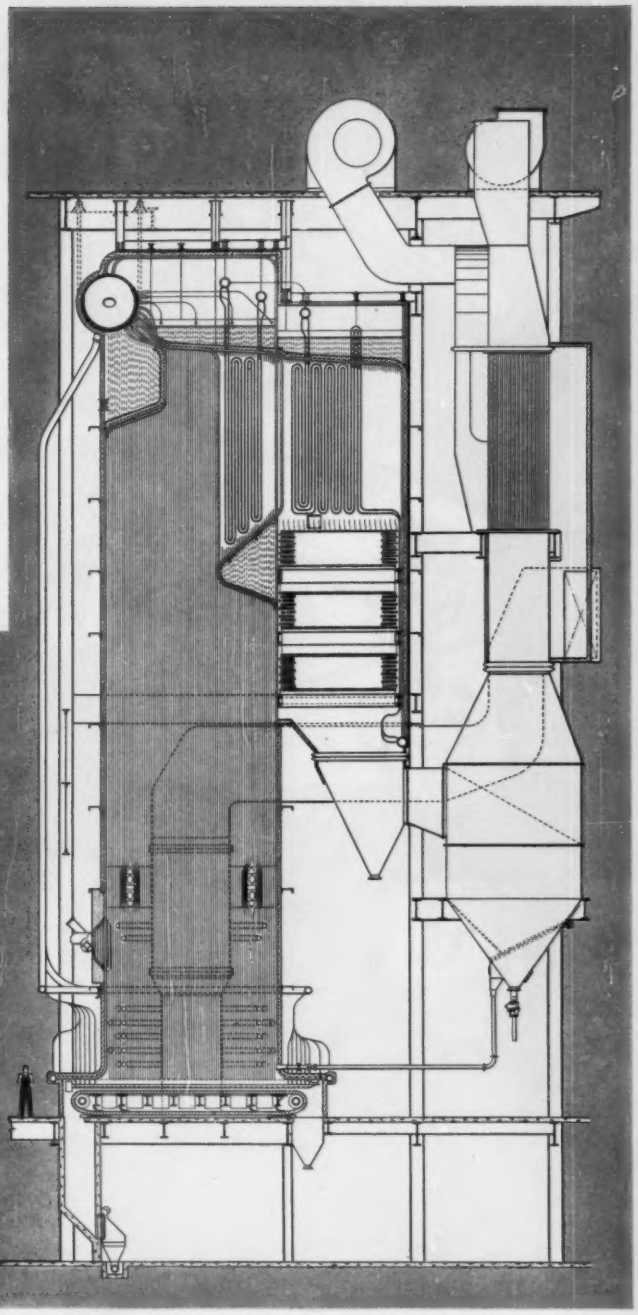
Displayed below are three – of the many – C-E stoker-fired boiler designs which, collectively, are suitable for any coal-firing conditions.

At the right is illustrated the latest – and largest – example of the C-E Bark-burning Unit, a design pioneered by Combustion and now widely used for burning bark, hogged-wood and other waste wood fuels.

So – when you are in the market for coal or other solid-fuel-burning units it will certainly be to your advantage to find out what Combustion Engineering has to offer. Our engineers will be glad to discuss your needs with you or your consultants. B-892



This C-E Unit is being installed for a soap company. It comprises a C-E Vertical-Unit Boiler, Type VU-50 fired by a C-E Traveling Grate Stoker. Coal used is Midwest Bituminous. This boiler is designed for a capacity of 100,000 lb steam per hr at 850 psig and 585 F. It is an outdoor type unit.

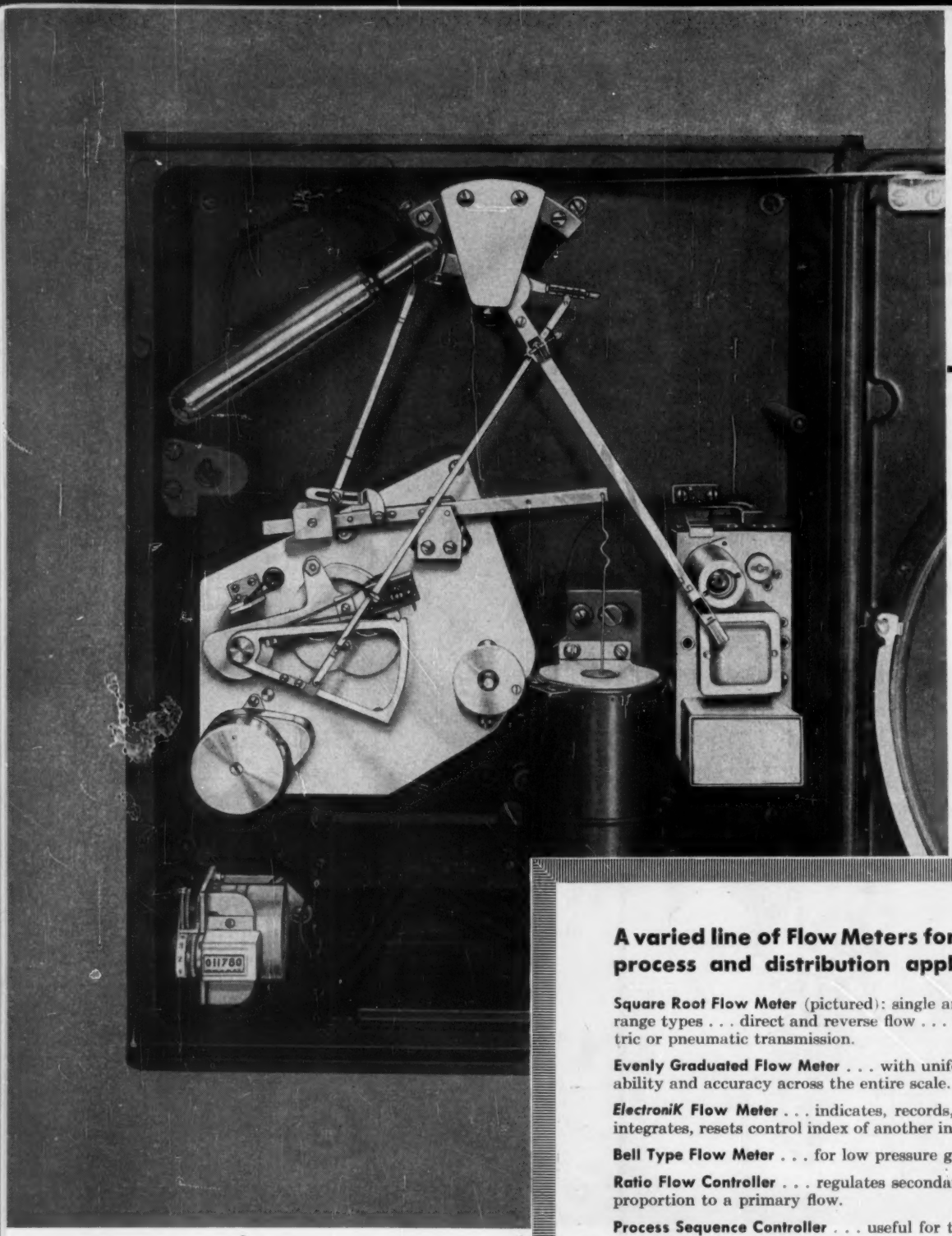


C-E Bark-Burning Unit for a paper company. This is a very large unit; capacity – 450,000 lb steam per hr, operating pressure – 1335 psig; total steam temperature – 958 F. It is designed to burn bark, natural gas, oil or any combination thereof. C-E Bark-Burning Boilers are in service for capacities as low as 20,000 lb of steam per hr.

ENGINEERING

CANADA: COMBUSTION ENGINEERING-SUPERHEATER LTD.

FLASH DRYING SYSTEMS; PRESSURE VESSELS; DOMESTIC WATER HEATERS; SOIL PIPE



A varied line of Flow Meters for every process and distribution application

Square Root Flow Meter (pictured): single and double range types . . . direct and reverse flow . . . with electric or pneumatic transmission.

Evenly Graduated Flow Meter . . . with uniform readability and accuracy across the entire scale.

***ElectroniK* Flow Meter** . . . indicates, records, controls, integrates, resets control index of another instrument.

Bell Type Flow Meter . . . for low pressure gases.

Ratio Flow Controller . . . regulates secondary flow in proportion to a primary flow.

Process Sequence Controller . . . useful for timing the addition of reagent to a preset cycle.

Parshall Flume Meter . . . for measuring flow in open channels and weirs.

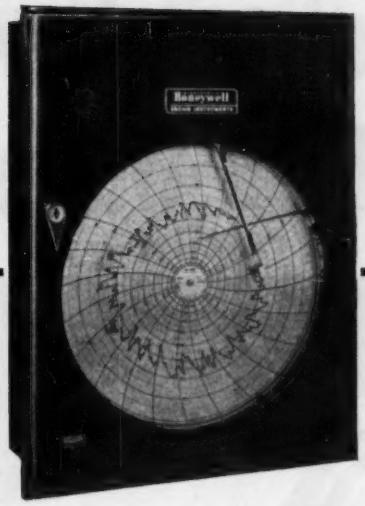
***Tel-O-Set* Miniature Instruments** . . . for graphic panels and other applications where space is at a premium.

Area Flow Meter . . . electric meter body for use with viscous fluids.

Differential Converter . . . the mercuryless flow transmitter with high sensitivity, precision and rangeability.

▲ *Reference Data:*

Write for Catalog 2321, "Flow Meters, Indicating, Recording, Integrating, Controlling."



The Brown Flow Meter line

was designed for your process applications

An important reason why Brown flow meters give you better performance is that they were designed specifically for flow recording, integration and control in industrial processes. Far from being step-children of boiler plant instruments, they embody features that fit the needs of modern production technology. Their design has been refined and perfected throughout 28 years of experience in flow instrumentation . . . to assure you of the utmost in precision, versatility and reliability.

For measurement, Brown Flow Meters give you a complete range of meter bodies to work with any fluid at any pressure . . . either electrical or pneumatic transmission . . . and the flexibility of interchangeable range tubes.

For integration, Brown Flow Meters feature accurate, simple electronic flow integration, in a design that places no mechanical load on the measuring mechanism.

For control, Brown Flow Meters, particularly those with square root calibration, offer an unequalled variety of control actions to match the needs of the simplest to the most complex process requirements.

For service, Brown Flow Meters give you basically simple and rugged designs that cut maintenance to the minimum . . . plus the convenience of prompt assistance in start-ups, routine maintenance and emergencies, by Honeywell specialists located near your plant.

Ask your local Honeywell sales engineer to discuss your flow applications. He's well qualified to give competent consultation . . . and he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.—in Canada, Toronto 17, Ontario.

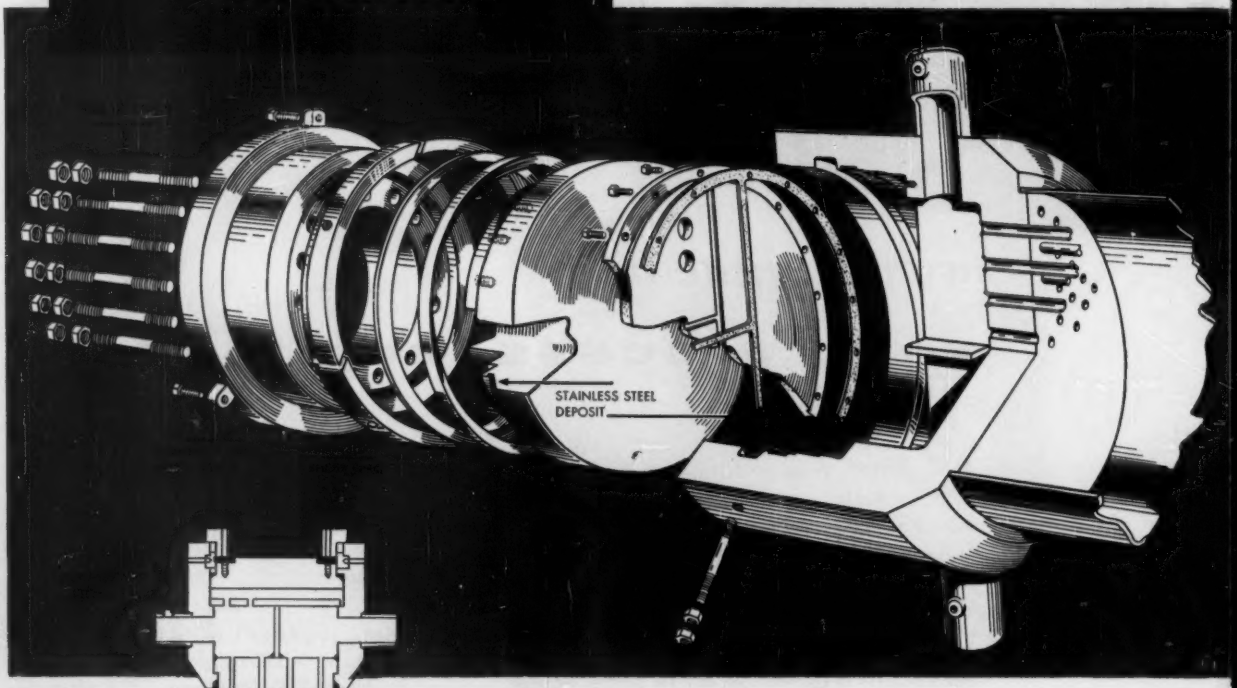
MINNEAPOLIS **Honeywell**

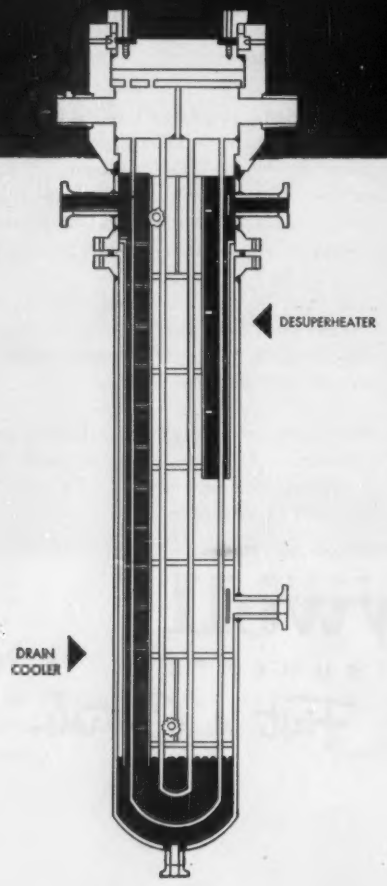
BROWN INSTRUMENTS

First in Controls

ATTENTION
POWER PLANT OPERATING ENGINEERS

see how feed water



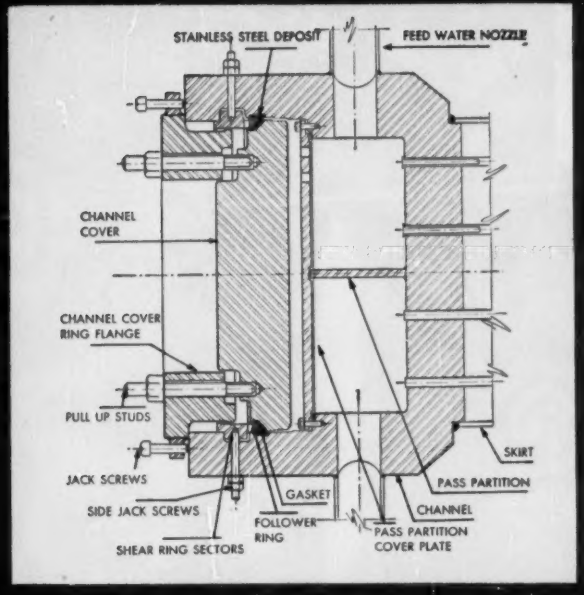


Exploded view and blueprint show construction detail of the unique closures exclusive with A. O. Smith feed water heaters. Cutaway drawing illustrates the closure as a part of the heater.

Note! In the A. O. Smith closure only one gasket is used. As a result, there's far less chance for leakage. Moreover, the closure is so designed that when pressure increases, sealing efficiency increases, too. Corrosion problems are eliminated by the fact that no mating surfaces are exposed to fluids and gasket contact areas on channel and channel cover are reinforced by stainless steel deposits. Overall construction is simple, thoroughly functional. What's more, A. O. Smith has the facilities and experience to build *standard* high-pressure closures.

Where conditions require, A. O. Smith feed water heaters can be supplied with desuperheating and drain-cooling shrouds for maximum efficiency.

A. O. Smith closure design cuts heater maintenance costs!



Pictured and described here are the closure features that help make A. O. Smith feed water heaters stand-out performers in power plant operation. Think of these features in terms of economy and in terms of years of continuous outage-free operation .

- **You get a positive seal from the start . . . the moment pressure bolting is tightened.**
- **Easy-in, easy-out. Design simplicity keeps closure assembly and disassembly down to 5 hours—less than a single shift.**
- **Parts are compact, easy to handle.**

When it comes to feed water heaters, you'll profit most by contacting A. O. Smith first. Exchanger designs, proved through years of service, make specifications of 1,000 to 10,000 psi standard in our exchanger and vessel shops. Our thermal design group is widely recognized as one of America's finest. Write today for detailed information.

- **Closures operate with one set of pressure bolting. Servicemen can get into the work quicker, easier.**
- **Closure gasket can be replaced without removing closure cover.**
- **No need to replace gasket after disassembling for maintenance.**

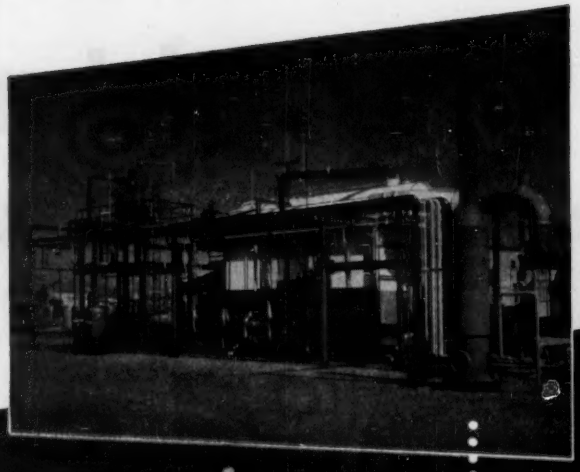
Through research ... *a better way*

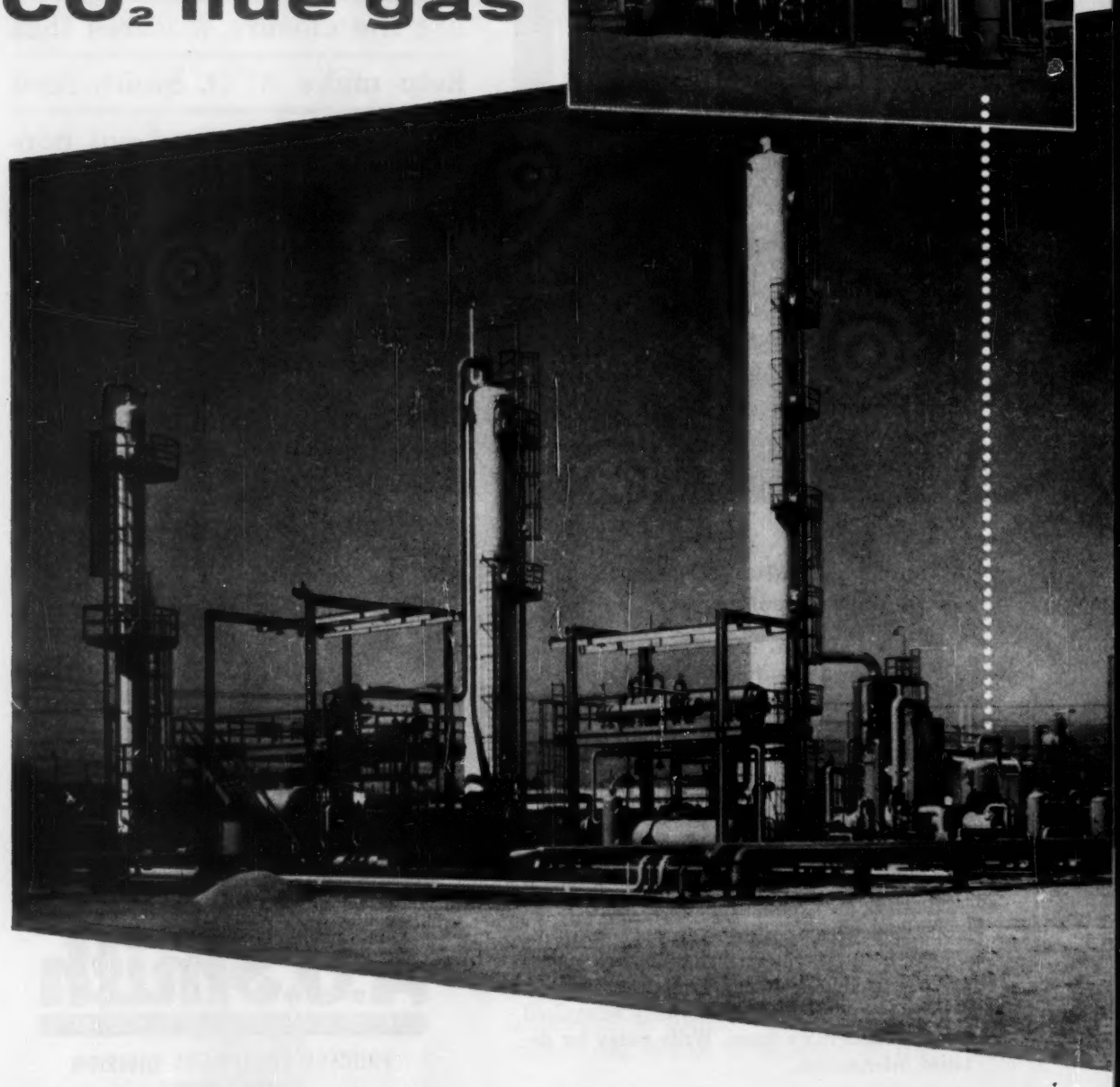
A.O.Smith
CORPORATION

PROCESS EQUIPMENT DIVISION
Milwaukee 1, Wisconsin
Chicago 4 • Cleveland 15 • Houston 2 • Los Angeles 22 • New York 17
International Division: Milwaukee 1, Wis.

Everything depends on

ERIE CITY VL
selected because of its high---
CO_2 flue gas





--the boiler flue gas ~ at this $1,500,000 Liquid plant

Liquid Carbonic Corporation, world's largest producer of CO_2 in liquid, gas and dry ice forms, operates the world's most automatic processing plant, of its kind, at Oakland, California

• Boilers used in the manufacture of dry ice and liquid CO_2 are specially designed and are an integral part of the process. When Liquid Carbonic specified the quantity of CO_2 to be produced at its Oakland, California plant, Erie City engineers met their stringent requirements. They designed and built the boiler, holding excess air to a minimum, while insuring complete combustion to obtain a high CO_2.

The entire operation at this plant is dependent upon the quantity of CO_2 that leaves the boiler. Unlike other boilers, steam production in this VL is incidental but is fully utilized to power the process.

Liquid Carbonic Corporation has for years found Erie City boilers dependable in this unique, severe application. The Oakland, California installation is one of many with Erie City boilers.

You, too, can depend on Erie City for sound engineering. Whatever type of steam generator you require, remember that Erie City designs and manufactures the most complete line, including all major components, to offer one single responsibility. There's over 116 years of experience to serve you.

If you would like the complete story on the Erie City VL write for SB-432.

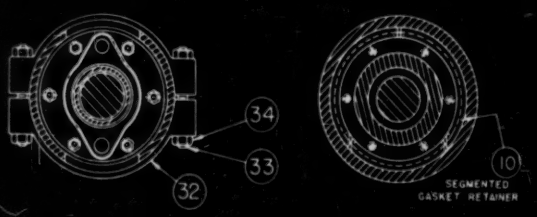
ERIE CITY
116 Years in Steam Generation

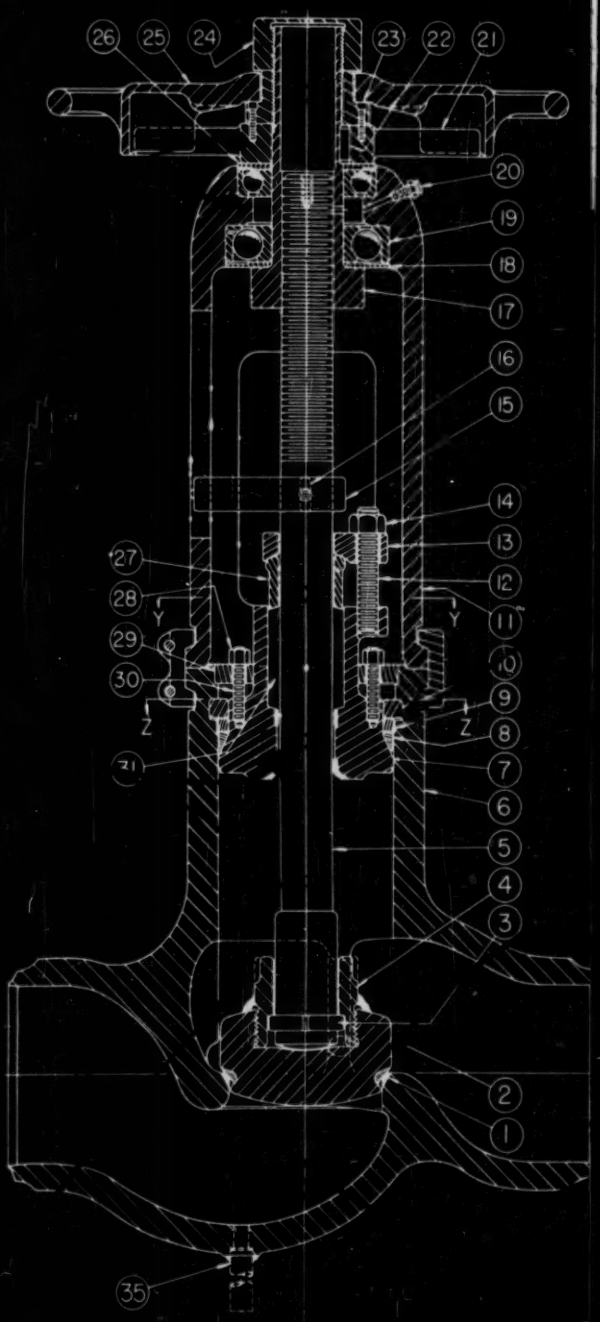
You can depend on Erie City for sound engineering

ERIE CITY IRON WORKS • *Erie, Pa.*

STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS
UNDERFEED AND SPREADER STOKERS • PULVERIZERS

D.C.H. –
Note comments.
These features
are worth money
to us! C.R.E.





ROCKWELL BUILT *Edward Valves*

LIST OF MATERIALS
QUANTITIES ARE FOR ONE VALVE
WHERE A.S.T.M. SPECIFICATIONS ARE INDICATED, THE LATEST REVISION APPLIES

PIECE NO.	NAME OF PIECE	NO. REQ'D	MATERIAL	SPECIFICATIONS	EDWARD M.S. NO.
4	SEAT	1	INTEGRAL WITH BODY	STELLITED	481
5	DISK	1	FORGED ALLOY STEEL WITH STELLITED SEATING FACE	A.S.T.M. A182, GRADE F11 WITH C0.12% MAX-CR 1.4% MO 1/2%	227 481
[illegible]	STEM COLLAR	1	EVALLOY	A.S.T.M. A182, GRADE F6	212
[illegible]	DISK NUT	1	EVALLOY	A.S.T.M. A182, GRADE F6	212
[illegible]	STEM	1	EVALLOY	A.S.T.M. A182, GRADE F6	212
6	BODY		CAST STEEL C-0.30% MAX	A.S.T.M. A216, GRADE WCB	102
			CAST STEEL C-0.20% MAX	A.S.T.M. A217, GRADE WC6	226
			CAST STEEL C-0.18% MAX.	A.S.T.M. A217, GRADE WC9	242
7	BONNET	1	CAST STEEL C-0.25% MAX	A.S.T.M. A217, GRADE WC1	209
8	PRESSURE SEAL GASKET	1	ARMCO IRON - 90 BHN MAX.	MALLEABLE PLATED	506
9	SPACER RING	1	STEEL		
10	GASKET RETAINER	1	EVALLOY	A.S.T.M. A182, GRADE F6	212
11	YOKE	1	CAST STEEL C-0.30% MAX	A.S.T.M. A216, GRADE WCB	102
12	GLAND STUDS	2	ALLOY STEEL	A.S.T.M. A193, GRADE B7	208
13	GLAND FLANGE	1	STEEL PLATE	A.S.T.M. A212, GRADE B	115
14	GLAND BOLT NUTS	2	STEEL	A.S.T.M. A194, CLASS 1 OR 2	124
15	STEM GUIDE COLLAR	1	STEEL PLATE	A.S.T.M. A212, GRADE B	115
16	STEM GUIDE KEY	1	STEEL	S.A.E. 1020	
17	YOKE BUSHING	1	CAST BRONZE	A.S.T.M. B-148 GRADE 9B-MT	432
18	BEARING WASHER	1	STEEL-EVALIZED	A.S.T.M. A212, GRADE B	115
19	ANGULAR CONTACT BALL BEARINGS			S.A.E. STANDARD	
20	ALEMITE FITTING	1	BUTTON-HEAD INDUSTRIAL TYPE		
21	CROSSARM	1	CAST STEEL C-0.30% MAX	A.S.T.M. A216, GRADE WCB	102
22	CROSSARM KEY	1	STEEL	S.A.E. 1020	
23	HANDWHEEL BUSHING	1	BRASS	A.S.T.M. B62	412
24	HANDWHEEL LOCKNUT	1	STEEL PLATE	A.S.T.M. A212, GRADE B	115
25	IMPACTOR HANDWHEEL	1	CAST IRON	A.S.T.M. A126, CLASS A	301
26	BEARING WASHER	1	STEEL-EVALIZED	A.S.T.M. A212, GRADE B	115
27	GLAND	1	STEEL	A.S.T.M. A105, GRADE II	111
28	BONNET RETAINER-NUTS	6	STEEL	A.S.T.M. A194, CLASS 2H	127
29	BONNET RETAINER RING	1	STEEL PLATE	A.S.T.M. A212, GRADE B	115
30	BONNET RETAINER STUDS	6	ALLOY STEEL	A.S.T.M. A193, GRADE B7	208
31	PACKING RINGS		HIGH TEMPERATURE PACKING		
32	YOKE LOCK RING	1	CAST STEEL C-0.30% MAX	A.S.T.M. A216, GRADE WCB	102
33	YOKE RING STUDS	4	ALLOY STEEL	A.S.T.M. A193, GRADE B7	208
34	YOKE RING STUD NUTS	8	STEEL	A.S.T.M. A 94, CLASS 2H	127
35	DRAIN NIPPLE	1	CHROME MOLYBDENUM	SCHEDULE 160 PIPE	229

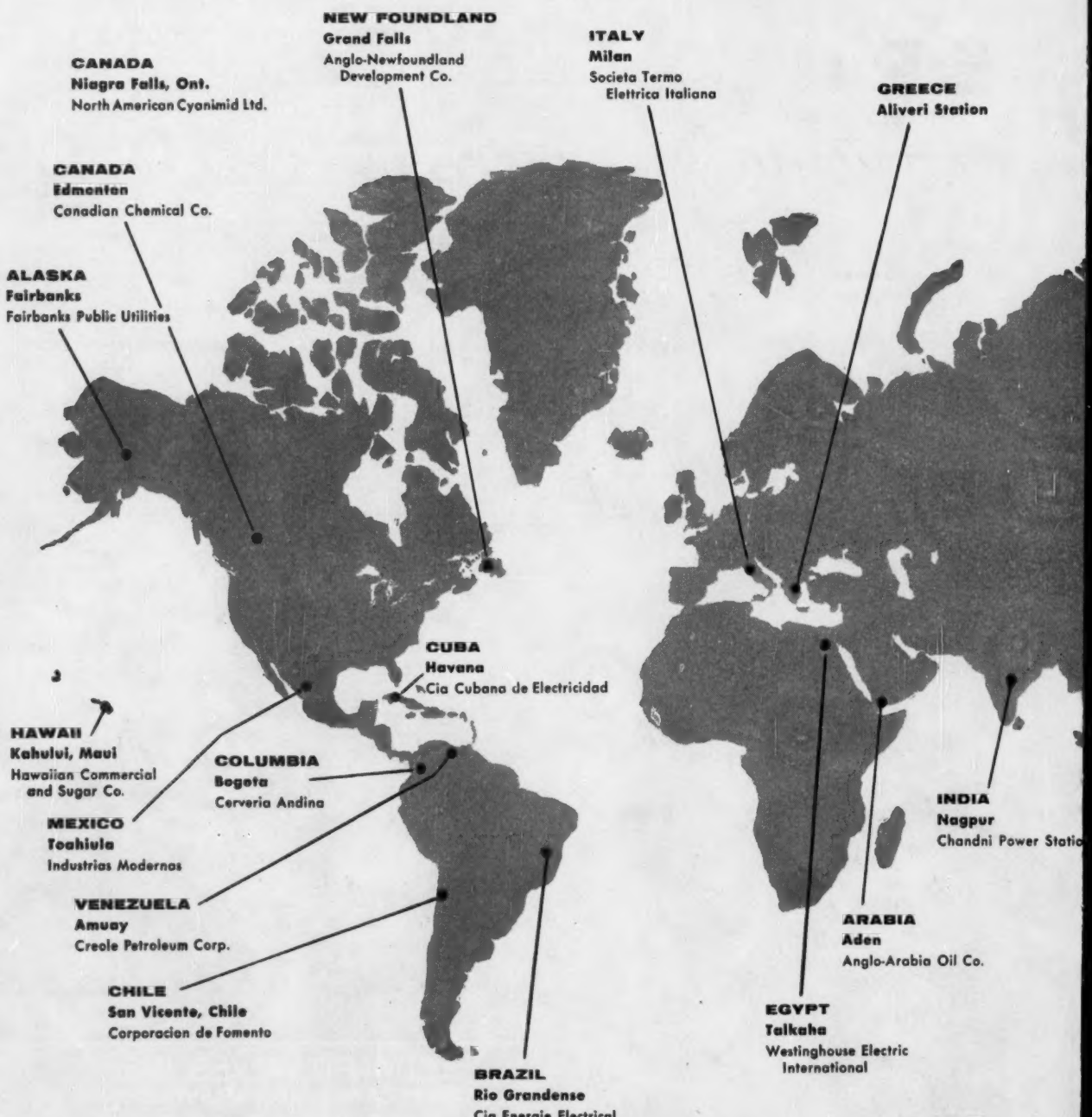
EDWARD VALVES, INC.
SUBSIDIARY OF ROCKWELL MANUFACTURING CO.
EAST CHICAGO, INDIANA

EDWARD GLOBE STOP VALVE
PRESSURE SEAL BONNET — WELDING ENDS
GENERAL ASSEMBLY

DRAWN [illegible]		DRAWING NO.
CHK'D [illegible]		AE-3297-5
APP'D [illegible]	DATE:	

Edward builds Globe and Angle Stop, Non-Return, Stop-Check, Check, Gate, Blow-Off, Mudline, Relief, Hydraulic, Instrument, Gage, and Special Valves and Strainers.

Choose the Combustion Controls



THIS IS ONLY A PARTIAL REPRESENTATION OF POWER PLANTS OUTSIDE OF THE UNITED STATES WHICH RELY ON REPUBLIC CONTROLS.

REPUBLIC FLOW METERS CO.

with a World-Wide Reputation

REPUBLIC *Automatic* COMBUSTION CONTROLS

Combustion efficiency is spelled and pronounced many different ways throughout the world. It's even expressed in two different units — pounds or kilograms of steam produced per unit of fuel consumed. No matter how you spell or measure it, however, its importance is the same to power plants everywhere — in ancient Peru or the distant Philippines.

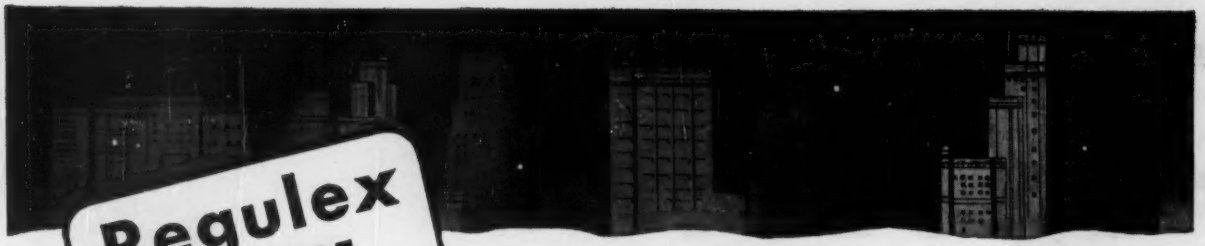
To get maximum combustion efficiency in power plants all over the world, engineers have specified Republic Controls again and again. With Republic, they know they are getting an extra "plus" in dependability because Republic Controls are ruggedly built to match the high availability of other equipment in the plant.

In *your* plant, insure maximum combustion efficiency and dependability by specifying Republic. At your service is an engineering staff with more than 35 years of specialized experience in power plant control to help you design the system that best meets your needs.

REPUBLIC Automatic COMBUSTION CONTROLS

- **For all types and sizes of boilers**
- **For all types of fuel**
- **For all types of firing**
- **For all arrangements of draft**
- **For all load conditions**

2240 Diversey Parkway • Chicago 47, Illinois



Regulex VOLTAGE REGULATORS

when loads are light

Keep Generators Stable

When the city sleeps, power demands are light. As the load drops, high power factor operation may cause generator instability.

Why *Regulex* Control?

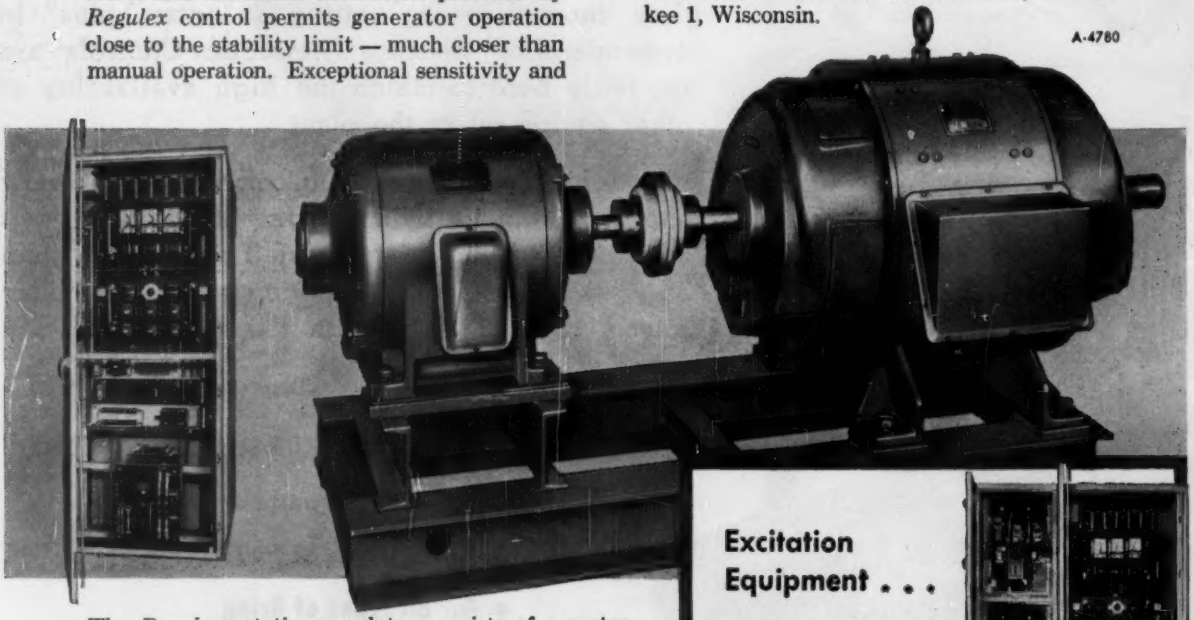
Conventional voltage regulators in power plants cut down excitation, but do not promote stability. *Regulex* control recognizes the stability problem and does not reduce excitation below the stable value.

How It Works

Automatic minimum excitation provided by *Regulex* control permits generator operation close to the stability limit — much closer than manual operation. Exceptional sensitivity and rapid response of the *Regulex* regulator and associated equipment establish and maintain a safe ratio between generator load and field current. As a result, operating limits are broadened at any power factor loading . . . proper reactive kva division is assured.

In power plant applications, *Regulex* voltage regulators may be used with alternators or synchronous condensers. No multiple special fields are required in the exciter. Get all the facts. See your A-C representative or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.

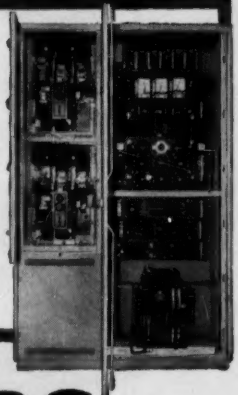
A-4780



The *Regulex* rotating regulator consists of a motor-generator set and a cubicle containing the static regulator element. The cubicle may be installed in any convenient spot or combined with switchgear equipment. Because there are no moving parts in the static regulator element, adjustment and maintenance are eliminated.

Excitation Equipment . . .

consists of main and spare exciter field breakers in a lineup with static equipment.

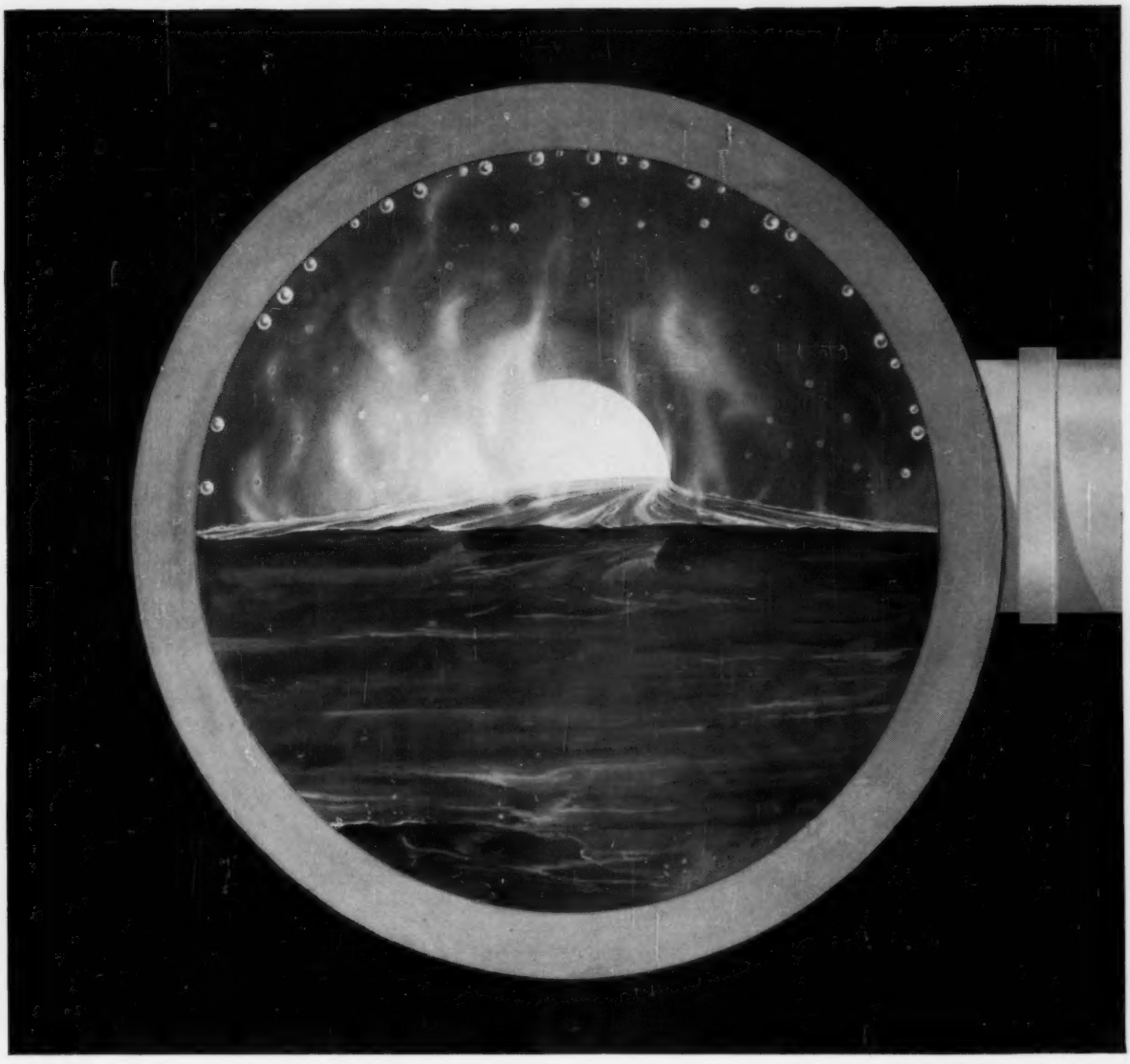


Regulex is an Allis-Chalmers trademark.

A-C ALLIS-CHALMERS

ALLIS-CHALMERS

A-4780



WHAT'S A MONOMOLECULAR FILM?

It is a film one molecule thick. Filmeen* in steam or condensate lines produces a monomolecular film.

But, there's a lot more to it than thickness. The film's most important function is protection against corrosion. By forming a nonwettable coating on all metal surfaces with which treated steam or condensate come in contact, Filmeen provides a protective, corrosion-inhibiting barrier between water and metal. In heat exchange equipment, the condensed steam treated with Filmeen then forms as spherical drops of water which resist adherence to the film surface, much the same as a drop of water will form into a small ball on a waxed surface. This phenomenon results in increased rate of heat transfer—which in turn saves money in power plant operation.

When steam condenses on untreated return lines, it forms a continuous layer of water that restricts heat transfer. You don't want that... it raises the cost of heat.

Your Dearborn sales engineer will gladly explain how Filmeen can keep your heating costs in line.

**Filmeen is the trade-mark of a corrosion-inhibiting compound produced exclusively by Dearborn Chemical Co. U.S. Pat. No. RE 23614.*

Dearborn®

a leader in water conditioning and corrosion control

Dearborn Chemical Company
Dept. PO, Merchandise Mart Plaza, Chicago 54, Ill.

Please send me complete information about Filmeen.

Name.....*Title*.....

Company.....

Address.....

City.....*Zone*.....*State*.....

Depend on LADISH

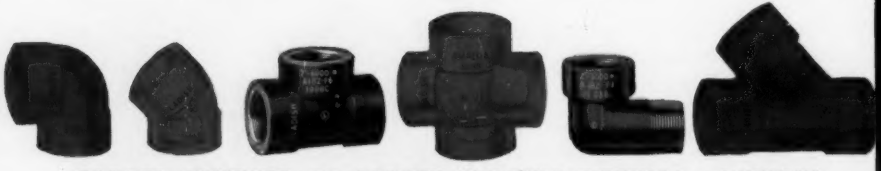
- Carbon Steels
- Carbon-Molybdenum Steels
- Chromium-Molybdenum Steels
- Nickel Steels
- Chromium-Nickel Steels
- Chromium-Silicon-Molybdenum
- Wrought Iron
- Chromium Type Stainless
- Chromium-Nickel Stainless
- Molybdenum Type Stainless
- Wrought Aluminum
- Aluminum-Copper Alloys

BUTT WELDING FITTINGS

½ inch through 42 inches . . .

FORGED CORROSION RESISTANT—LIGHT WEIGHT and A.S.A. FLANGES

½ inch through 24 inches . . .



FORGED SCREWED OR SOCKET WELDING FITTINGS and UNIONS

⅛ inch through 4 inches . .

LARGE DIAMETER AND T.E.M.A.* STANDARD FLANGES up to 20 feet O.D.

*Tubular Exchanger Manufacturers Association

LONG WELDING NECKS up to 24 inches, 150 lb. through 2500 lb.

Complete Service . . .

BUTT WELDING FITTINGS

Schedules 5S, 10S, 40S, 80S, and other Schedules and wall thickness.

FORGED CORROSION RESISTANT—LIGHT WEIGHT and A.S.A. FLANGES

150 lb. through 2500 lb. pressure ratings.

FORGED SCREWED OR SOCKET WELDING FITTINGS and UNIONS

150 lb. Corrosion Resistant and 2000 lb. through 6000 lb. ratings.

FOR FITTINGS FROM ANY FORGEABLE MATERIAL TO MEET YOUR SERVICE REQUIREMENTS

You get prompt, efficient service when you specify and order from the complete Ladish Controlled Quality line. Fittings *in any forgeable material* in virtually every type, size, wall thickness or pressure rating . . . are produced to one uncompromising Controlled Quality standard . . . and identified with heat code symbols pioneered by Ladish as verification of metallurgical integrity resulting from exhaustive tests made in the Ladish metallurgical laboratories.

For *complete service* on your fittings requirements, depend on the Ladish line and the services of your Authorized Ladish Distributor.

THE COMPLETE *Controlled Quality* FITTINGS LINE

LADISH CO.

CUDAHY, WISCONSIN

MILWAUKEE SUBURB

District Offices: New York • Buffalo • Pittsburgh • Philadelphia • Cleveland
Chicago • St. Paul • St. Louis • Atlanta • Houston • Odessa • Tulsa
Los Angeles • San Francisco • Seattle • Havana • Mexico City • Brantford, Ont.

L

TO MARK PROGRESS

- Aluminum-Manganese Alloys
- Deoxidized Copper
- Hastelloy
- Titanium
- Forging Brass
- Everdur Bronze
- Silicon Bronze
- Manganese Bronze
- Wrought Nickel
- Nickel-Copper Alloys
- Inconel
- Monel

Now the finest of needle valves is available

416 Stainless throughout...

In the Marsh Needle Valve, operating men found a valve that was better all the way through. Then came the call for a valve of like quality and precision for corrosion service . . . to be 416 stainless steel throughout.

The valve illustrated here is the answer. Like the parent valve, this new valve has safety and strength to spare . . . guaranteed for working pressures up to 10,000 psi . . . equally efficient and effective in any lower pressure range.

It too is machined from solid bar stock—in this case, 416 stainless steel. Its precision-ground and-machined stem is hardened 416 stainless. Packing is the special "Marpak" ring . . . one-piece, non-binding, long-lasting. So finely built is this needle throttling and cut-off valve that it can be easily throttled down to exceptionally fine regulation even on extreme pressure.

Read the list of features opposite. Then write for new bulletin No. NV-2 containing complete details.

The new all stainless valves (Series 1924) includes globe and angle patterns with double female connections in sizes ⅛", ¼", ⅜", ½", ¾", 1"; also globe and angle valves with male inlet and female outlet in sizes ¼" and ½".

MARSH INSTRUMENT CO. Dept. F, Skokie, Ill.
Sales affiliate of Jas. P. Marsh Corp.

Marsh Instrument & Valve Co. (Canada) Ltd.
8407 103rd Street, Edmonton, Alberta, Canada

HOUSTON BRANCH PLANT: 1121 Rothwell Street, Sect. 15, Houston, Texas

416 Stainless Steel ...all the way through!

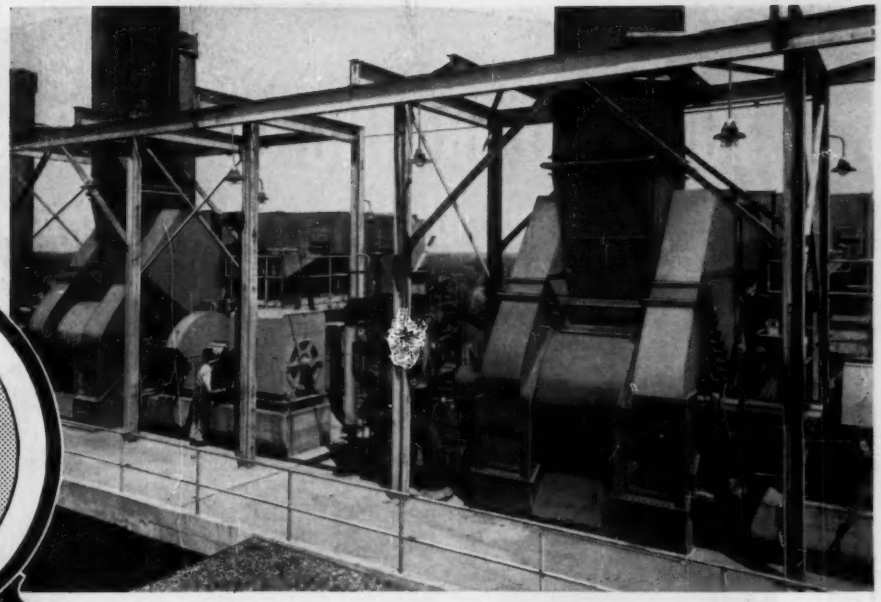
- Body and stem guide machined from bar stock.
- Valve stem, hardened stainless.
- Packing, special Marsh "Marpak" moulded ring.
- Fine stem threads for strength and precision throttling.
- Deep inlet and outlet thread chambers.
- Bodies marked in accordance with MSS regulations.

Maximum Working Pressure 10,000 P.S.I.

Water, oil, gas or corrosive fluids not injurious to 416 stainless steel.

MARSH

"THE STANDARD OF ACCURACY"



MARATHON

chooses marathon performers in the mechanical draft field

Clarage Fans Installed at Ohio Oil's Refinery, Robinson, Ill.

"Best in the long run" is Marathon's slogan for its gasoline. But there's growing opinion that these five words aptly describe Clarage equipment as well.

For example, Ohio Oil's $3,500,000 improvement and expansion program for their power plant required the removal of Clarage induced draft fans which had been on the job continuously since 1926. Think of it, nearly 30 years of service under the most punishing conditions a fan can encounter. Value received — in full!

Small wonder that two Clarage Type RT induced draft fans and two Clarage Type W forced draft fans were selected to serve the two 180,000 lbs. per hour Riley boilers in the modernized plant.

These fans are installed outdoors on an elevated platform, and are equipped with dual drives arranged for automatic control on both the turbine drive and the motor drive. The turbine is kept hot at all times so that it will start operating automatically in the event of failure of the motor, magnetic coupling, or electrical system.

If, like The Ohio Oil Company, you want marathon performers in the mechanical draft field, by all means investigate the equipment we offer. CLARAGE FAN COMPANY, Kalamazoo, Michigan.

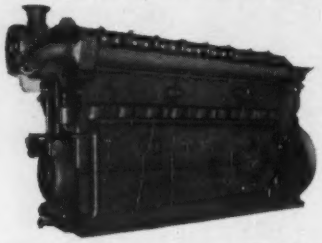
CLARAGE ... *dependable equipment for making air your servant*

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal

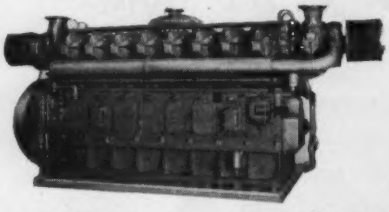
TOP PERFORMING Cooper-Bessemers

for every heavy-duty power and compressor need

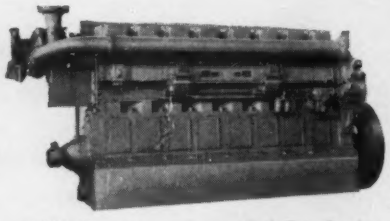
TYPE LSV .....12 or 16 cyl.
Atmospheric and Supercharged
Gas..... 1440 to 5000 hp.
Diesel and Gas-Diesel..1650 to 5000 hp.



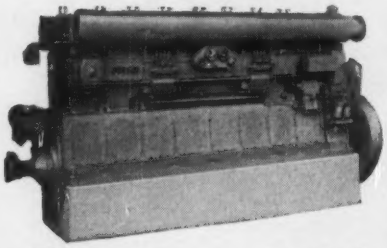
TYPE LS .....6, 7, 8 cyl.
Atmospheric and Supercharged
Gas ..... 660 to 2500 hp.
Diesel and Gas-Diesel.. 965 to 2500 hp.



TYPE FVA..... 6, 8, 12 or 16 cyl.
Diesel — Atmospheric .....310 to 835 hp.
Diesel — Supercharged ...560 to 2200 hp.



TYPE JS.....5, 6, 7 or 8 cyl.
Atmospheric and Supercharged
Gas .....325 to 1815 hp.
Diesel and Gas-Diesel....430 to 1815 hp.



TYPE GS..... 5, 6 or 8 cyl.
Atmospheric and Supercharged
Gas .....320 to 1460 hp.
Diesel and Gas Diesel....300 to 1460 hp.

● Available in a range of sizes from 100 to 5000 hp., Cooper-Bessemer engines and compressors are ready to meet *your exact requirements.*

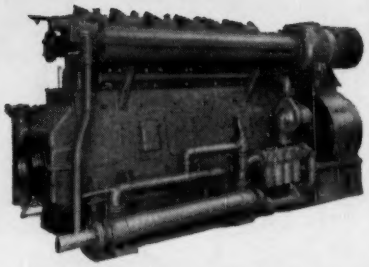
The standard units shown here are typical of the many "top performers" now offered by Cooper-Bessemer. With "Tri Fuel" operation of most 4-cycle engines, and a new line of centrifugal compressors, Cooper-Bessemer continues to put into practice its policy of "Another Example of Efficient Power at Lower Cost".

Here, to list but a few, are plus values that make *every* Cooper-Bessemer a natural choice when it comes to purchasing new engines or compressors . . . low-cost operation, unmatched efficiency, extreme compactness, long-life dependability, easy accessibility, minimum maintenance and more than a century of engine building experience.

New bulletins offer the latest information. Get your copy by writing: The Cooper-Bessemer Corporation, Mt. Vernon, O.

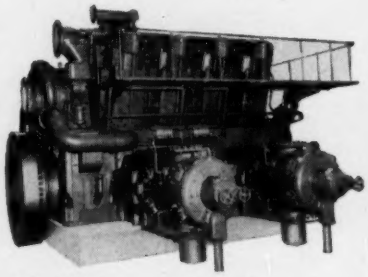
MOUNT VERNON, OHIO
COOPER-BESSEMER
GROVE CITY, PENNA.

New York, N. Y. • Washington, D. C. • Gloucester, Mass.
San Francisco, Calif. • Houston, Texas • Seattle, Wash.
Los Angeles, Calif. • Chicago, Illinois • St. Louis, Mo.
San Diego, Calif. • New Orleans, Louisiana
Cooper-Bessemer of Canada, Ltd., Halifax, Nova Scotia.

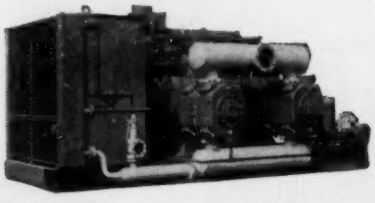


TYPE FWA .....6 cyl.
Diesel — Atmospheric ...245 to 500 hp.
Diesel — Supercharged .420 to 835 hp.

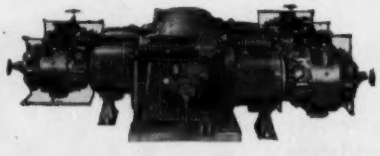
TYPE GMWA.....6, 8 or 10 cyl.
Gas Engine Driven Compressors
.....1500 to 2500 hp.



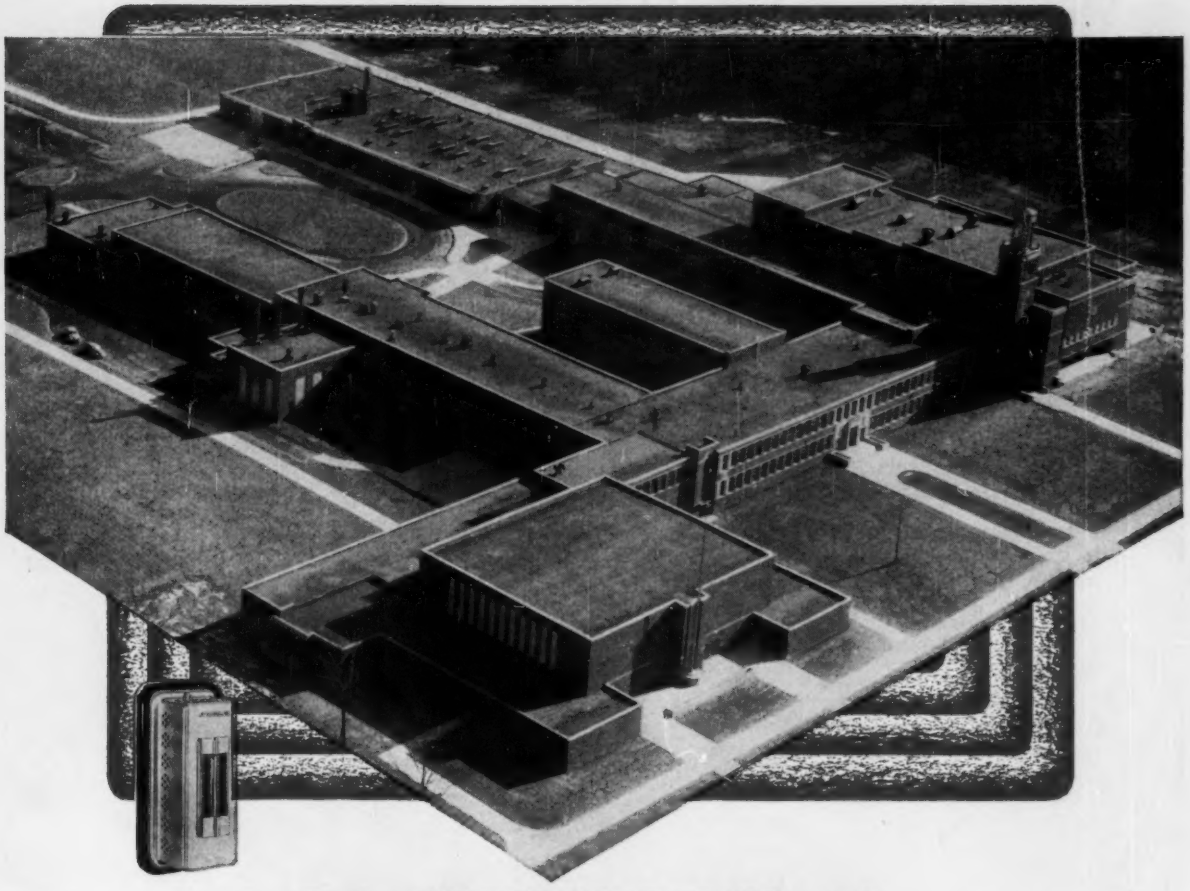
TYPE GMVA ..... 4, 6, 8, 10 cyl.
Gas Engine Driven Compressors
.....540 to 1350 hp.



TYPE GMXD .....4, 6, 8 or 10 cyl.
Packaged Unit
Gas Engine Driven Compressor . 265 to 660 hp.



M-LINE RECIPROCATING COMPRESSORS
100 to 5000 hp. 9″-14″ stroke
Speed to 514 RPM



Rate HEATING PLANT with JOHNSON CONTROL "Most Nearly Perfect"

Educational facilities at the new $5 million Senior High School* in Parma, Ohio, are widely acclaimed as among the nation's finest. Equally impressive are the building's mechanical features, notably its highly efficient heating and ventilating systems.

Comfort *could* be a real problem in this building. Its size alone creates special problems. So do the large number of rooms, which vary in area from little more than 100 square feet to more than 10,000 square feet. Other factors affecting comfort include the use and occupancy levels in such diversified locations as classrooms, offices, the 540-seat cafeteria and social center, the library, the 1,800 capacity auditorium and numerous others.

All of these problems, and more, are compensated for by a specially engineered system of Johnson Automatic Temperature Control which operates the heating and ventilating systems and insures ideal temperatures for every purpose.

Here's what George Rose, the school's engineer, has to say about it: "Our heating system is the most nearly perfect one I have seen. The automatic control system helps keep our fuel expenditures at a minimum. Yet it gives us the flexibility we need to satisfy all comfort requirements throughout the building. It also reduces the need for operating personnel and requires very little maintenance."

Any building—small or large, new or existing—can enjoy these same superior comfort and economy advantages of a Johnson engineered Control System. An engineer from a nearby Johnson branch will gladly discuss your temperature control problems and give you his recommendations without obligation. Johnson Service Company, Milwaukee 1, Wisconsin. Direct Branch Offices in Principal Cities.

**Parma Senior High School, Parma, Ohio. Fulton, Krinsky & Dela Motte, architects; L. B. Mumma, mechanical engineer; The Feldman Brothers Company, heating contractor; all of Cleveland.*

JOHNSON CONTROL

TEMPERATURE ↕ AIR CONDITIONING

PLANNING • MANUFACTURING • INSTALLING • SINCE 1885

Wickes Boilers selected by one of America's newest, most up-to-the-minute automotive parts and accessories plants

WICKES

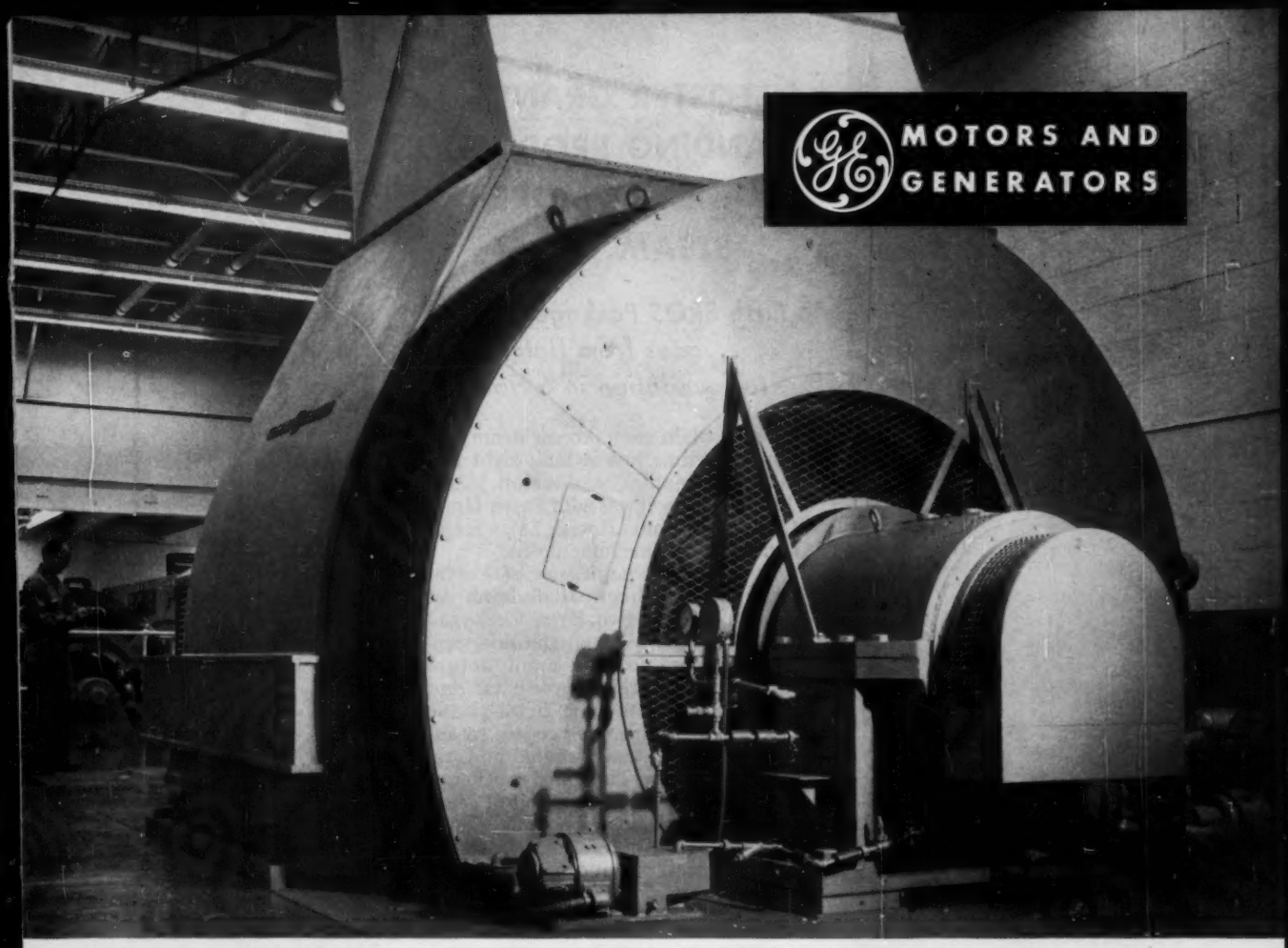
These two Wickes steam generators were installed recently in one of America's most modern automotive parts plants. Each delivers 66,000 lbs. of steam per hour, has a boiler and water wall heating surface of 7340 sq. ft. and an air pre-heater of 5225 sq. ft. Design pressure is 200 psi, operating pressure 150 psi, and water feed temperature 225°F. In factories, institutions, municipal buildings, refineries, processing plants, and many other installations throughout the country, Wickes boilers are supplying dependable, low-cost heat and power. Wickes builds water tube steam generators in a great variety of types and sizes to fill the individual needs of any application. If you are building new facilities, or wish to replace your present steam generator with a newer, more efficient one, contact Wickes. We will be pleased to send you our new 24 page bulletin No. 55-1 containing complete information on Wickes steam generators and fabrication facilities.

THE WICKES BOILER CO.

DIVISION OF THE WICKES CORPORATION • SAGINAW, MICHIGAN

RECOGNIZED QUALITY SINCE 1854 • SALES OFFICES: Albuquerque, N. M. • Boston • Buffalo • Charlotte, N. C. • Chicago • Cleveland • Dallas • Denver • Detroit • Fort Wayne, Ind. • Houston • Indianapolis • Los Angeles • Memphis • Milwaukee • New York City • Portland, Ore. • Saginaw • Salt Lake City • San Francisco • Springfield, Ill. • Tulsa • Washington, D. C.

160



GENERATOR WITH BASE RATING OF 60,000-KVA HELPS CREATE OPERATING CONDITIONS FOR LARGE MOTOR RESEARCH IN NEW G-E LAB.

In New G-E Development Laboratory Giant Motors Perform Just as in Service

One of the difficult problems design engineers face is predicting accurately how a giant motor will perform under operating conditions. General Electric has come up with an answer to this problem.

INCREDIBLY ACCURATE TEST CONDITIONS are made possible by the brand new G-E test laboratory pictured above. Heart of the test room is a synchronous generator with a base rating of 60,000-kva driven by a variable speed d-c motor to provide test current of variable frequency. A motor-generator set to supply the d-c current, exciter sets and elaborate switchgear make it possible to simulate test conditions far more severe than are encountered in the field.

DATA GAINED FROM TESTING today's motors and generators will be directly applied to the design and development of tomorrow's machines. Product development like this is an integral part of General Electric's continuing program to provide you with dependable, compact, efficient electric equipment.

Take advantage of this progressive engineering research and bring your large motor and generator problems to General Electric. For more information on G-E motors and generators call the nearest General Electric Apparatus Sales Office. General Electric Company, Schenectady 5, N. Y. 770-41

Progress Is Our Most Important Product

GENERAL ELECTRIC

9:00 A.M.

10:12 A.M.

11:00 A.M.

11:45 A.M.

FOSTER GRANT'S EXPANDING PRODUCTION MEANT MORE STEAM... FAST

Fifth BROS Packaged Boiler ...goes from flatcar to foundation in 6 Hours

How to obtain more process steam with minimum time loss is built right into many companies' expansion plans. That's the way it was with Foster Grant Co., Inc., of Baton Rouge, La., a major styrene plastic manufacturer.

Back in '53, engineers of Foster Grant's petrochemical division set down the first two Bros Packaged Boilers. These went on the line, providing steam for the manufacture of FOSTA® styrene products and FOSTARENE® polystyrene. In the plastic boom, more steam was needed, so another Bros unit was installed and, recently, two more. The timed transfer of one of them from flatcar-to-trailer-to-foundation took but six hours.

... These units operated in series, provide a total steam capacity of 150,000 lbs. per hr. Each unit's design pressure is 600 lbs.

HERE'S REAL OPERATING ECONOMY

Because of the flexibility of packaged boilers operating in multiples, you exercise close control over steam requirements, keeping fuel costs down. Also, varying load conditions are easily accommodated. So there's real satisfaction to Foster Grant in having maximum operating efficiency, regardless of load conditions.

Design features, fast installation and operating economy make the Bros Packaged Boiler the logical choice in your expansion plans. Capacities range from 4,100 to 30,000 lbs. of steam per hour. Gas or oil fired or combination. Choice of manual, semi or fully automatic controls. Expertly designed boilers by boiler experts since 1882.

Write today for the factful Bros Packaged Boiler Catalog WT-7; no obligation, of course.

BROS

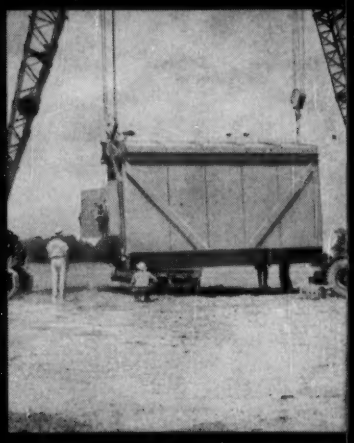
POWER DIVISION

WM. BROS BOILER & MFG. CO.

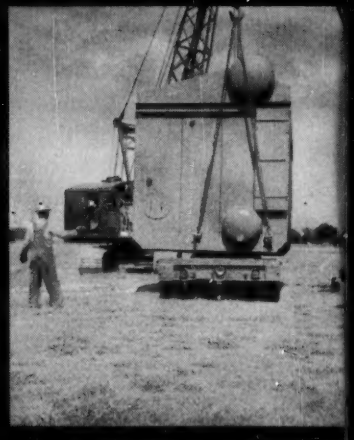
1055 Tenth Avenue, S.E.

MINNEAPOLIS 14, MINNESOTA

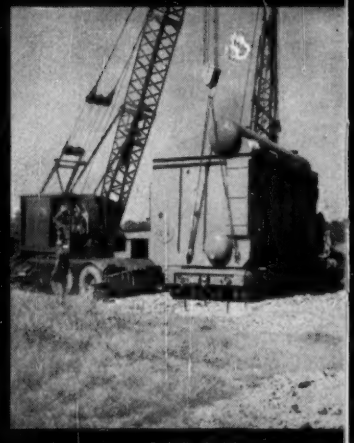
DESIGNERS AND MANUFACTURERS OF WATER-TUBE BOILERS, 2, 3, and 4 DRUM AND PACKAGED DESIGNS. AUXILIARY EQUIPMENT AND FULL LINE OF INDUSTRIAL STOKERS



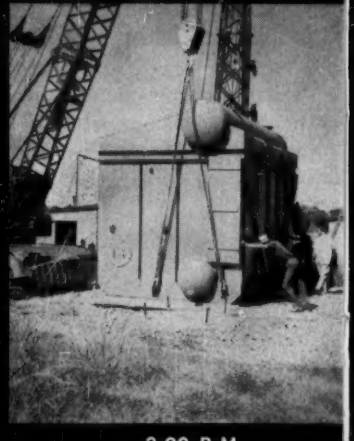
1:10 P.M.



1:45 P.M.



2:10 P.M.



3:00 P.M.

New pipe insulation has vaporproof and fireproof finish for fast application

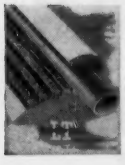
One fast operation combines application and finishing when you use Armstrong LT Cork Covering on cold lines. This entirely new kind of insulation is made of cork segments adhered to an aluminum foil and asbestos paper backing that seals out moisture vapor and resists fire. Application is amazingly fast. The paper flap is cemented quickly into place and end joints sealed with a vaporproof tape. Fittings are insulated with Armstrong Plasticork® or field fabricated covers of LT Covering.

LT Cork Covering is only one of the quality products in the complete line of Armstrong Industrial Insulations. Armstrong also offers you a contracting service, geared to install these products economically and efficiently.

Send for free booklet on LT Cork Covering or for information on other Armstrong products that can help you solve your insulation problems.

Armstrong

INDUSTRIAL INSULATIONS



☐ Armstrong LT Cork Covering, a New Cold Line Insulation

☐ Armstrong Armabestos* Pipe Covering and Block Insulation

☐ Armstrong Armatemp* Block and Blanket Insulation

☐ Armstrong Armaglas* Insulations for Pipes, Tanks, and Vessels

Armstrong Cork Company
2001 Riggs Ave.
Lancaster, Penna.

Please send me the free booklets checked. ☐
Please have an Armstrong representative call. ☐

Name .....

Position .....

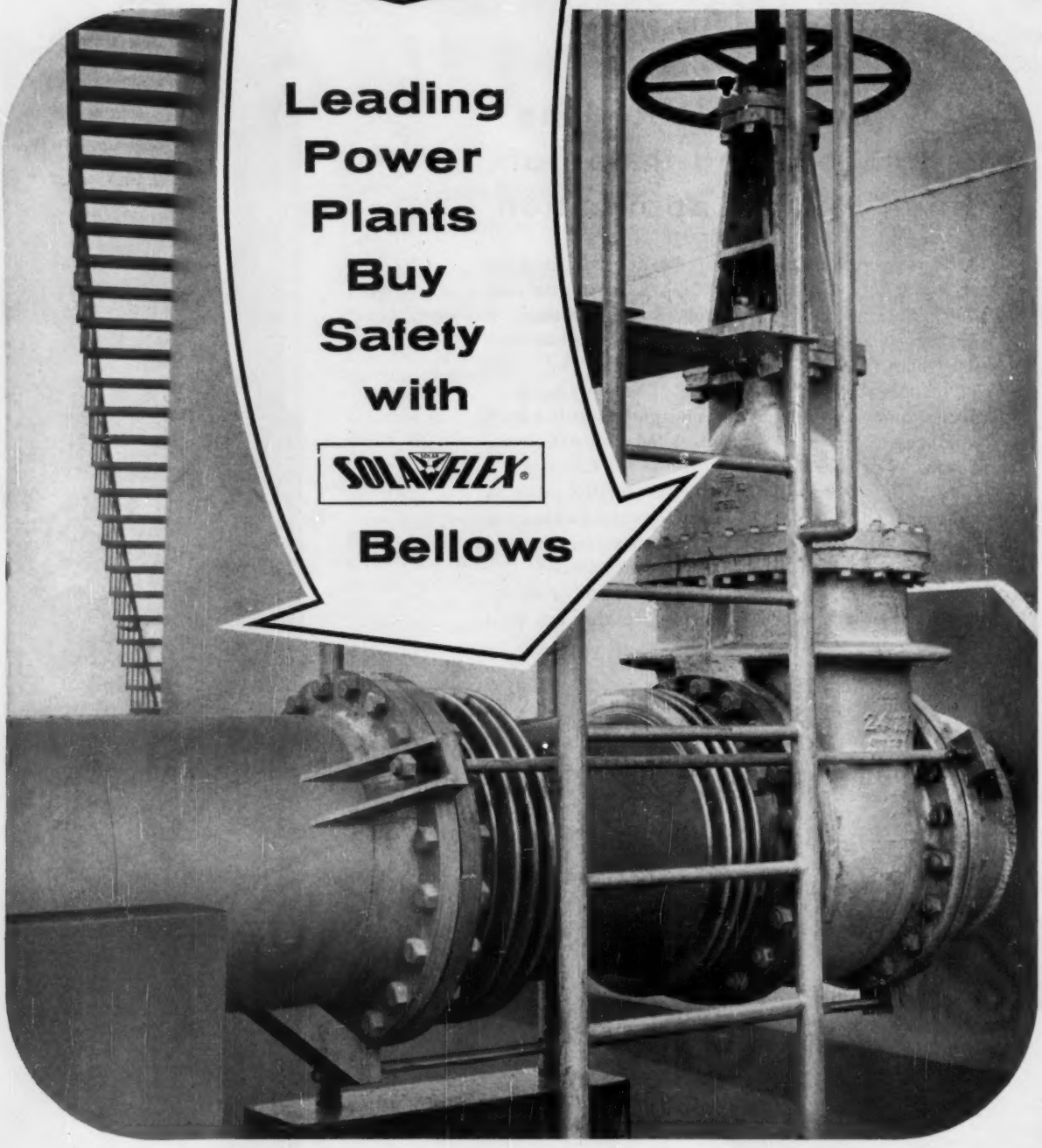
Company .....

Address .....

City ..... Zone .... State .....

*TRADE-MARK

Leading Power Plants Buy Safety with SOLA-FLEX® Bellows

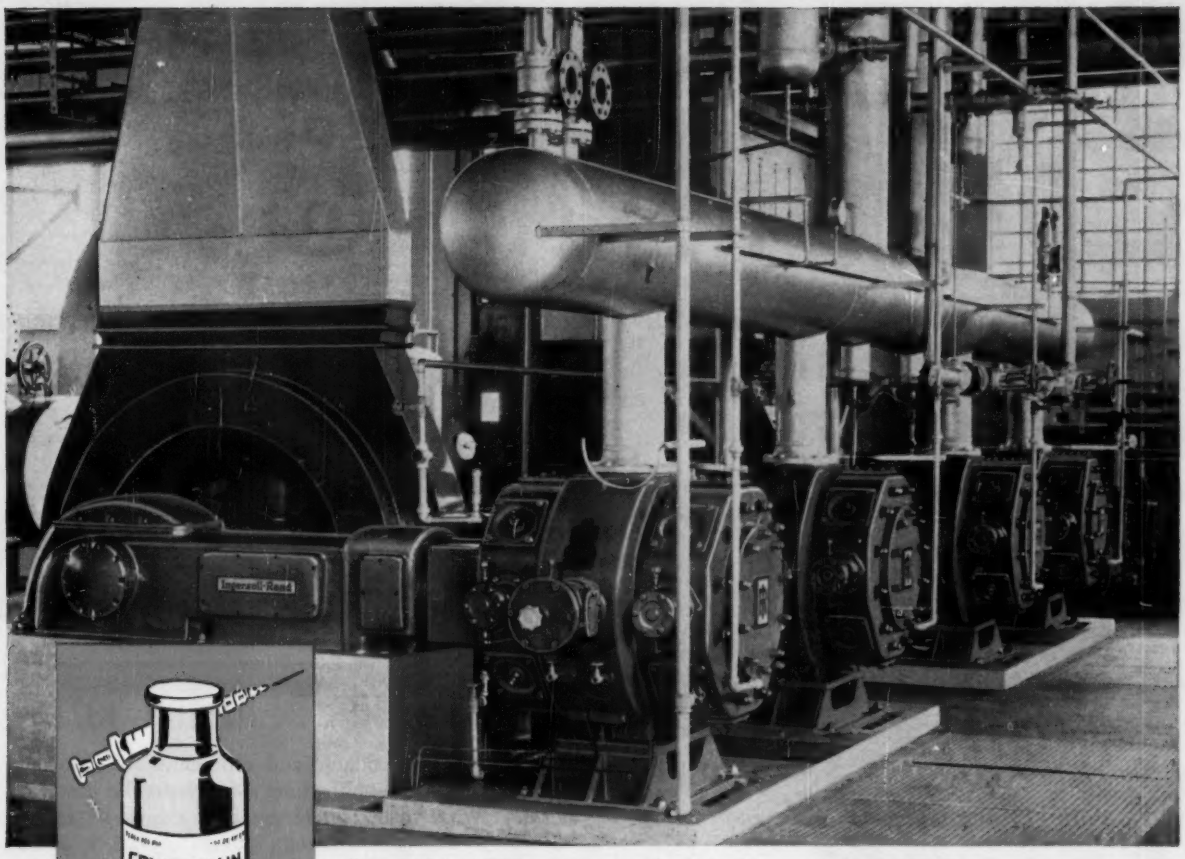


SOLA-FLEX EXPANSION JOINTS handle the movement of this big tank and pipeline at one of the Southwest's newest and finest power plants. The 24-inch joint takes axial and lateral offset movement due to changes in pressure, or temperature or to tank shifting. Valve operation is improved, and pipe and tank installations are protected from stresses absorbed by the joint.

Sola-Flex stainless steel bellows with built-in stress rings need no external harness or "strait jacket." The Sola-Flex line meets every piping problem—convoluted for vacuum or low pressure, U-span for medium and high pressure service—in standard pipe sizes and in rectangular shapes also. Send for Sola-Flex catalogs. Address Solar Aircraft Co., Dept. B-104, San Diego 12, Calif.

SOLAR
AIRCRAFT COMPANY
SOLAR
SAN DIEGO DES MOINES

DESIGNERS, DEVELOPERS AND MANUFACTURERS OF METAL ALLOY PRODUCTS · GAS TURBINES · BELLOWS · CONTROLS · HIGH TEMPERATURE COATINGS · AIRCRAFT COMPONENTS



Two 400 hp PRE compressors furnish oil-free air for the E. R. Squibb & Co. penicillin plant in Santa Amaro, Sao Paulo, Brazil

Penicillin manufacture demands clean, oil-free air

Compressed air is the best medium for the agitation and oxidation of antibiotic fermenters in the manufacture of penicillin. However, conventional compressors allow some of the lubricating oil from the compressor cylinder to carry over in the air which would contaminate the finished drug and perhaps kill the precious organisms that are vital to the process.

The solution to this problem was simple enough... Ingersoll-Rand NL non-lubricated compressor cylinders were specified. These cylinders use special carbon wearing rings and piston rings that require no external lubrication. And the only special maintenance required is a yearly check of piston clearance to determine if new wearing rings are required.

This famous NL construction, an Ingersoll-Rand first, is the answer to many compression problems where oil may not be used, whether it be in drug, food, power or chemical plants. NL cylinders can be furnished on compressors from ½ to 1000 horsepower. For further information contact your local Ingersoll-Rand representative or write.

Ingersoll-Rand

1-295 11 Broadway, New York 4, N. Y.

COMPRESSORS • CONDENSERS • AIR & ELECTRIC TOOLS • TURBO BLOWERS • PUMPS • ROCK DRILLS • GAS & DIESEL ENGINES

NEW TAYLOR BI-THERM* DIAL THERMOMETER

is so easy to read it invites frequent reading!

A SIMPLE, dependable and economical thermometer with many applications throughout the power industry. Wide variety of ranges from minus 40° to plus 750°F. 5" and 3" dials, stem lengths of 4, 6, 9, and 12 inches; separable wells of brass, steel, type 304 stainless steel or monel.

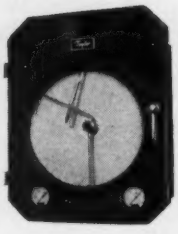
EASY TO READ: Black figures and graduations stand out.

RUGGED: All exposed metal parts are of arc welded, corrosion-resistant stainless steel. All instruments are waterproof.

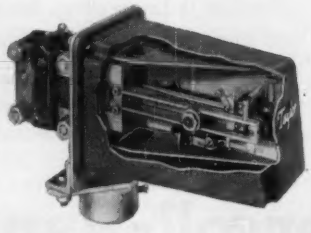
ACCURATE: The instrument is accurate within ±1% of range, over the entire range. Simple zero-setting features correct minor errors in readings which might result from severe mechanical shock. No ambient temperature effect. Overrange protection 50% up to 500°F.; 10% above 500°F.

VIBRATION DAMPED: Silicone damping in all instruments except 200° to 750°F. range results in increased speed of response, minimum pointer vibration, and elimination of pointer chatter.

ECONOMICAL: Costs only **$16** to **$26,** depending on dial size and length of stem. Ask your Taylor Field Engineer, or write for **Bulletin 98267.** Taylor Instrument Companies, Rochester, N. Y., or Toronto, Canada.



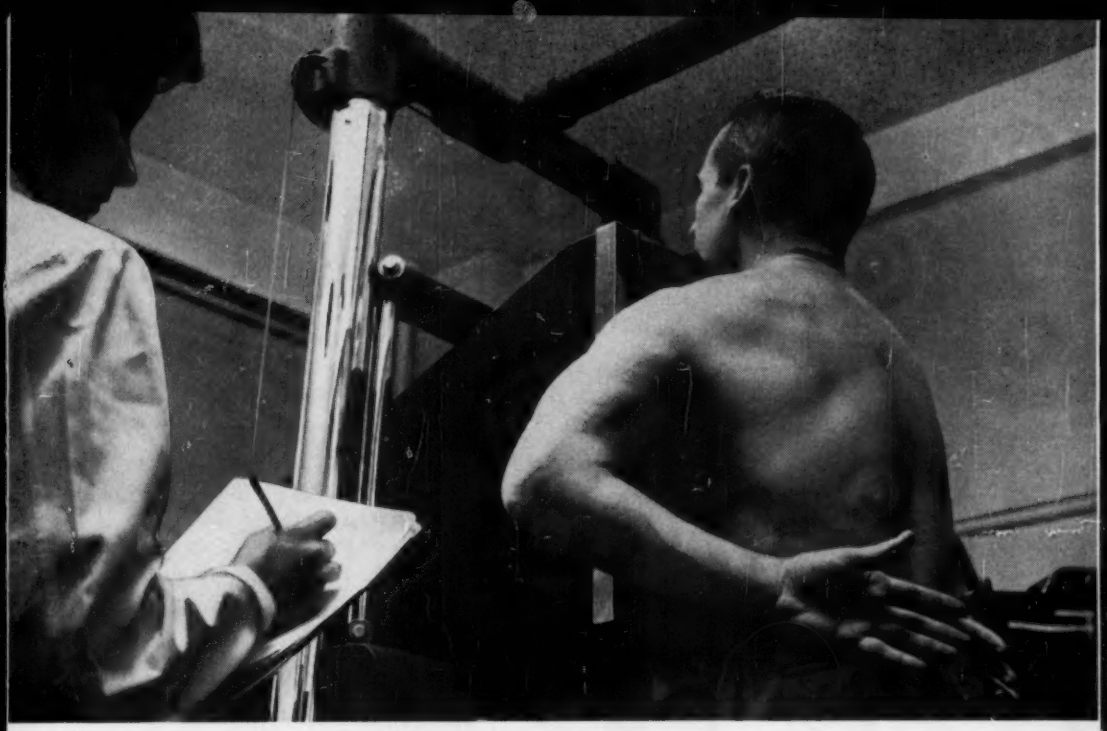
FULSCOPE* Recording Controller
For Desuperheaters, or for any close, accurate control of temperature, pressure, flow or liquid level. Quickly adapted to operating requirements.



TRANSAIRE* Differential Pressure Transmitter
A rugged, dependable and accurate instrument designed to measure flow, liquid level or specific gravity. A force-balance transmitter, it has a 1500 psi pressure rating and is available in two ranges; 20 to 200" and 80 to 800" of water.

*Trade Mark

Taylor Instruments
MEAN
ACCURACY FIRST
IN HOME AND INDUSTRY



better health . . . because of BRICK

It is hard to associate X-rays with brick—the refractory brick which contains the fires of industry. Yet, were it not for brick these fine X-ray machines would never be made, and there'd be no electricity to operate them.

From an autoclave to an automobile, from a scalpel to a skyscraper, everything that's made and every form of transportation, communication and power owe their existence to refractory brick.

Our job is to provide that brick. In infinite variety. Compounded to formulas as precise as a prescription, in the world's largest refractories research laboratory. Moulded from materials brought from many countries in plants strategically located across our country to serve industry swiftly . . . dependably . . . economically . . . everywhere.

GENERAL REFRACTORIES COMPANY
Philadelphia 2

GENERAL REFRACTORIES

A COMPLETE REFRACTORIES SERVICE FOR STEAM GENERATION

Monolithic furnace linings of GREFCO plastic firebrick are economical and will provide long uninterrupted service. Three high quality mixes are available for various furnace conditions with a selection of well engineered refractory and high temperature alloy metal anchors for various combinations and thicknesses.

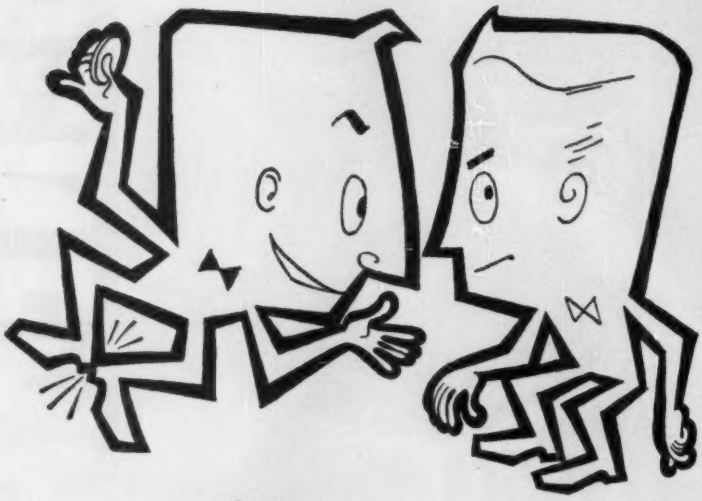
GREFCO plastics are manufactured at three strategically located plants in Pennsylvania, Missouri and Georgia. Stocks are maintained for prompt truck delivery at all company warehouses and dealers in principal cities.

When you specify GREFCO you are assured of quality second to none. The world's finest and best equipped refractory laboratory is constantly developing new products and improving old ones. District laboratories constantly check raw materials and finished products. GREFCO places great emphasis on uniform high quality.

SUPER BRIKRAM MIX-G—a super duty quality plastic firebrick with a special binder which provides an airset when material is air dried. Provides high strength throughout the entire thickness of the wall or arch.

SUPER BRIKRAM—a plastic firebrick of super duty quality for furnace linings where conditions warrant the use of super duty quality. Has excellent resistance to spalling and high temperatures.

BRIKRAM—a plastic firebrick of high duty quality. Excellent for patching or complete furnace linings where conditions do not require a super duty quality refractory.

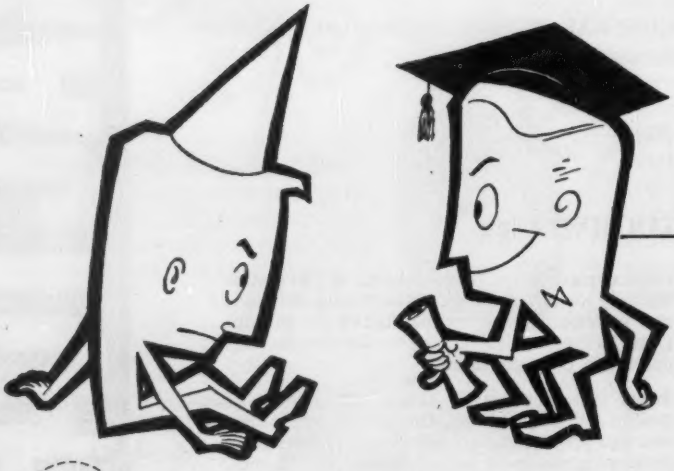


Look! I can buy coal for much less a ton than you're paying.

I used to buy that coal too, but it costs more per million BTU's with a whole lot more in hidden costs.

What do you mean by "hidden costs"?

That coal you're talking about is high in ash. So we were buying ashes at the coal price, paying freight on them from the mine, then paying to have them hauled away. Your "cheaper" coal clinkers; it smokes; it fouls the tubes. That means higher labor costs and higher maintenance. Now I pay more per ton and save thousands of dollars a year.



Coals produced on the C&O are tops in quality.

A C&O combustion engineer showed me why this grade of coal would work best in our type of installation and our experience has shown he was right. You'd better get some expert advice. It can save you money, too.

P.S.

There's a lot more to buying coal than the cost per ton. Why not contact coal producers on the C&O to solve your particular fuel requirements, or write to: R. C. Riedinger, General Coal Traffic Manager, Chesapeake and Ohio Railway Company, Terminal Tower, Cleveland 1, Ohio.

Chesapeake and Ohio Railway

WORLD'S LARGEST CARRIER OF BITUMINOUS COAL

THESE MIDWEST "LONG TANGENT" ELBOWS SAVED $4121 IN PIPE

MIDWEST "LONG TANGENT" ELBOWS COST NO MORE THAN OTHER ELBOWS

Here are 1227 Midwest "Long Tangent" Elbows (12″, 14″ and 16″ standard weight) ready for shipment to a chemical plant. Each Midwest "Long Tangent" Elbow has a straight section on each end equal in length to ¼ the nominal pipe size. Thus a 12″ elbow saves 6″ of 12″ pipe while a 16″ elbow saves 8″ of 16″ pipe. It doesn't take long to save a lot of pipe and a lot of money . . . in this instance $4121.

But saving pipe is not the only advantage of Midwest "Long Tangent" Elbows. They often eliminate short nipples and their extra welds . . . save time and money In lining up and clamping pipe and fittings . . . slip-on flanges are more easily applied. For all the facts, write for Catalog 54.

MIDWEST PIPING COMPANY, INC.
Main Office: 1450 South Second Street, St. Louis 4, Mo.
Plants: St. Louis, Passaic, and Los Angeles

Sales Offices
New York 7—50 Church St. • Chicago 3—79 West Monroe St.
Boston 27—426 First St. • Los Angeles 33—520 Anderson St.
Houston 2—1213 Capitol Ave. • Tulsa 3—224 Wright Bldg.
Cleveland 14—616 St. Clair Ave. • Miami 34—2103 LeJeune Road
STOCKING DISTRIBUTORS IN PRINCIPAL CITIES

MIDWEST WELDING FITTINGS

MIDWEST WELDING FITTINGS Improve Piping Design and Reduce Costs

705

Carrying coal in Delaware Valley with U.S. Rubber Conveyor Belts

(at right) U. S. Giant® Conveyor Belt, carrying coal from car dumper to breaker house.

Panoramic view of part of conveyor belt system utilizing U. S. Giant Conveyor Belting in power plant on the Delaware River.

To feed the four boilers in this power plant in the Delaware Valley, United States Rubber Company conveyor belts, capable of handling 300 tons of coal an hour, take the coal from hopper cars to breaker house to coal bunkers. Like so many other successful belting installations, this one is the result of United States Rubber Company's "Three-Way Engineering" —in which "U. S." engineers work with the engineers of the conveyor system and the power company engineers to turn out the most durable, economical belt system for the specific job. In America and abroad there are thousands of "Three-Way Engineered" jobs, some large, some small —but all steadily keeping output high, costs low. Get in touch with any of the 27 "U. S." District Sales Offices, or write to us at Rockefeller Center, New York 20, N. Y.

US RUBBER

Mechanical Goods Division

United States Rubber

why soot is no problem... with the Ljungstrom® Air Preheater

Soot is no problem with the Ljungstrom. Clinging soot or slag is loosened by normal expansion and contraction of the preheater . . . and most of it is blown away by the high-velocity gas streams. What remains is removed by superheated steam or compressed air, fired from oscillating soot blowers, while the Ljungstroms are in operation.

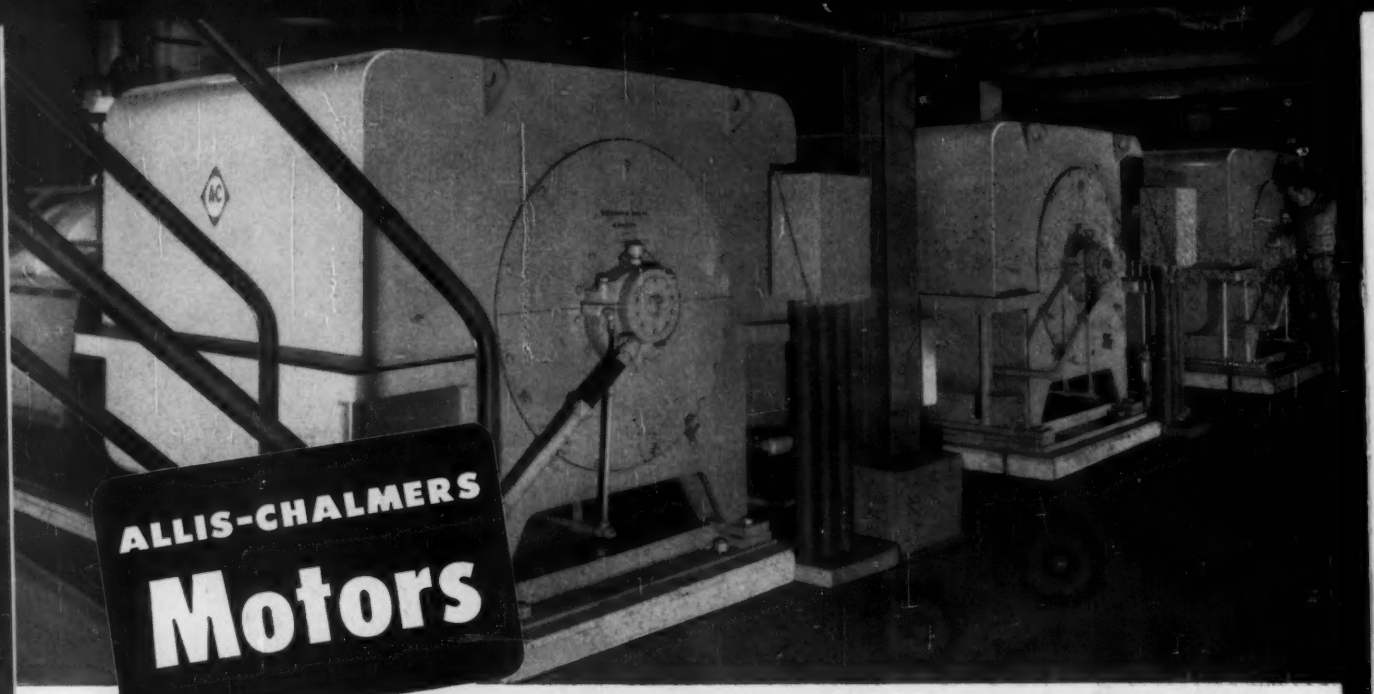
What's more, moderate deposits on the Ljungstrom heating surface have no effect on preheating. For, with the Ljungstrom, heat need not pass through a film-coated wall – but is simply absorbed by a heating surface and *released from the same surface.*

Get all the details on why the Ljungstrom is easier to clean and maintain . . . maintains higher boiler efficiencies. They're in the new, 38-page reference manual, "Ljungstrom Air Preheaters." Write for your free copy, today!

Advantages of the Ljungstrom Air Preheater

- Size for size, recovers more heat than any other type.
- Reduces fuel consumption. Permits use of lower-grade fuels. Increases boiler output and reliability.
- Eliminates cold spot . . . keeps corrosion to a minimum.
- Easier, faster to clean and maintain.
- Requires far less supporting steel and is quickly erected.

The Air Preheater Corporation 60 East 42nd Street, New York 17, N. Y.



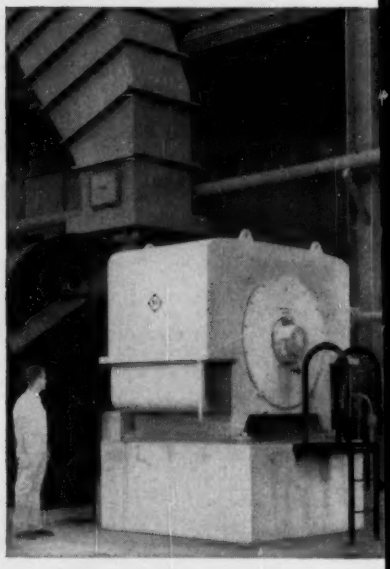
Driving ALL Major Auxiliaries

at Houston's New Webster Station

Weather-protected Allis-Chalmers motors are used throughout the modern outdoor Webster Station of Houston Lighting and Power Company. They provide low-cost outdoor installation plus dependable operation under all weather conditions.

These motors are but a few of the complete line of motors Allis-Chalmers builds for power plant service. Check with the A-C office in your district or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin. A-4832

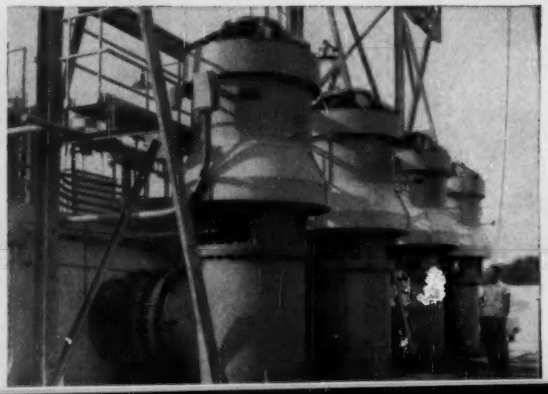
Three of the six 1750-hp, 3575-rpm, 2300-volt Allis-Chalmers two-pole motors providing unusually quiet drives for boiler feed pumps.



Two 350-hp, 1170-rpm, 440-volt Allis-Chalmers condensate pump motors.

One of four 1250-hp, 880-rpm, 2300-volt cage motors driving forced-draft fans.

ALLIS-CHALMERS



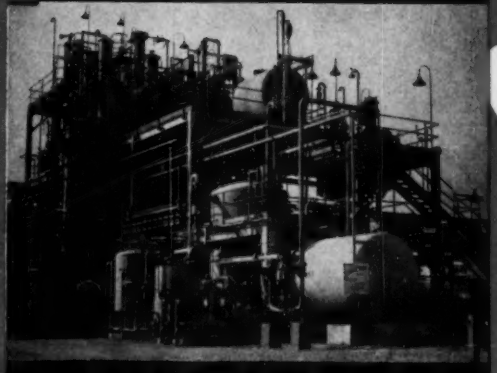
Four 800-hp, 514-rpm, 2300-volt vertical Allis-Chalmers circulating water pump motors.

Engineers and Constructors — Ebasco Services Incorporated

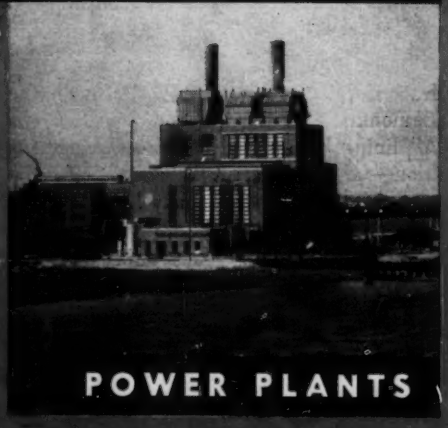
DROP FORGED STEEL

valves, fittings and flanges by Vogt

REFINERIES



CHEMICAL PLANTS



POWER PLANTS

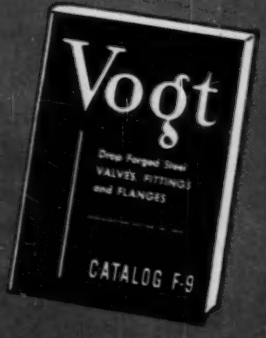
USED and TRUSTED by the NATIONS KEY INDUSTRIES

There are good reasons behind the trust which America's key industries have placed in Vogt valves, fittings, and flanges for half a century. They know that *drop forged materials* are uniform in structure, fine grained, and free from porosity. They know, too, and appreciate the meticulous care given these products through every stage of forging and machining in Vogt's modern shops, and about the many rigid tests and inspections. And that is why these products enjoy such an impressive record of performance in withstanding the shocks and stresses imposed by high or low pressures and temperatures and in resistance to erosive and corrosive conditions.

Service is another important factor in this confidence because Vogt maintains the world's largest and most complete stock of drop forged steel valves, fittings, and flanges always ready for immediate shipment.

Write for Catalog F-9. Consult its 400 pages for the complete Vogt line of drop forged steel valves, fittings, and flanges for oil, steam, water, air, gas, and refrigeration services.

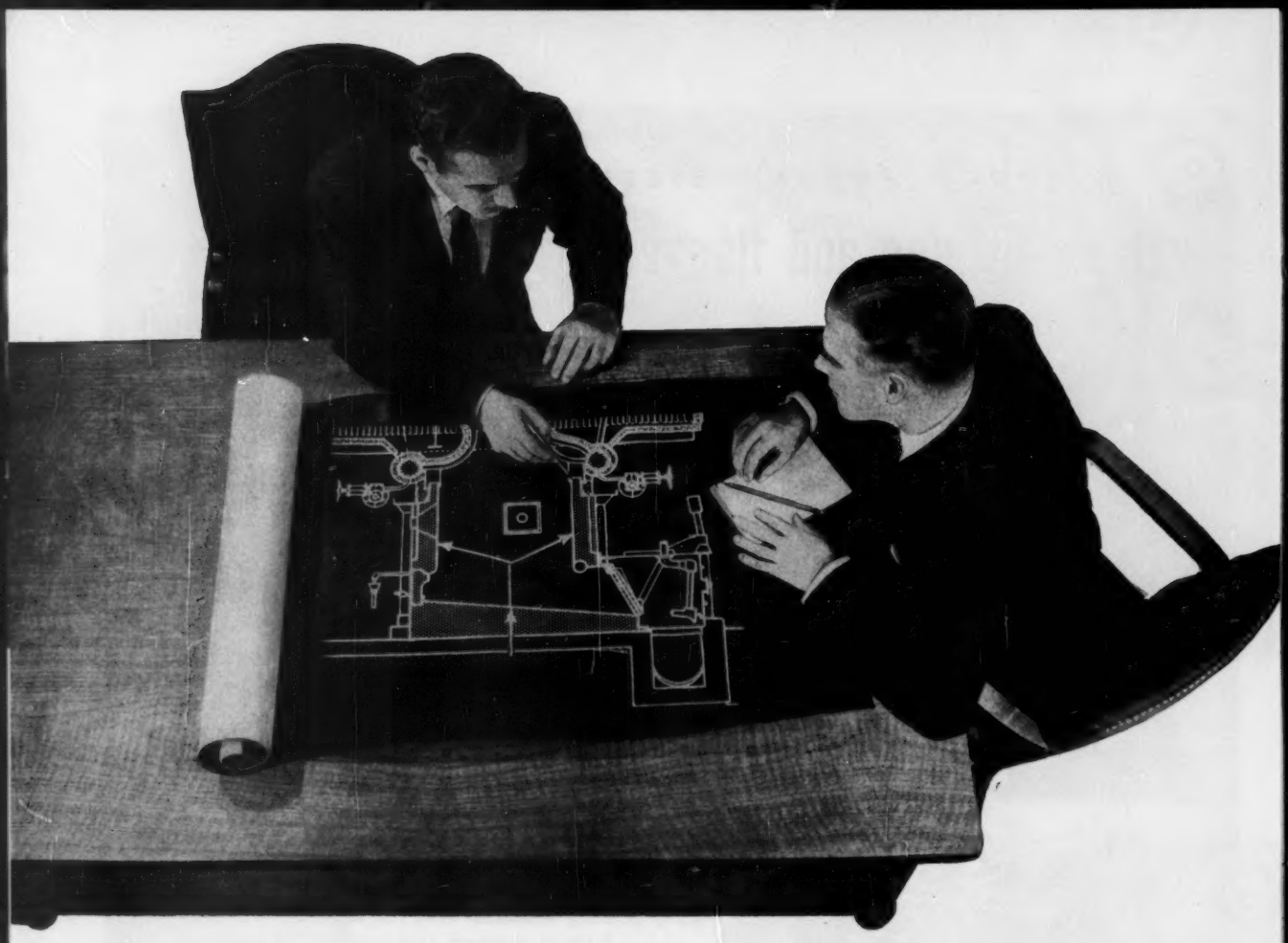
ADDRESS DEPT. 24-PP



HENRY VOGT MACHINE CO., LOUISVILLE, KY.

SALES OFFICES: New York, Philadelphia, Chicago, Cleveland, St. Louis, Cincinnati, Dallas, Charleston, W. Va., San Francisco

HENRY VOGT MACHINE CO. 75th Anniversary LOUISVILLE, KY.



PROMINENT PUBLIC UTILITY

Cuts ashpit maintenance with B&W Refractory Concretes

A trial installation of B&W Refractory Castable "A", a 2600 degree refractory concrete, was made in one boiler ashpit. To date this castable has given 25 months more maintenance-free service than the refractories previously used.

Results of this first trial were so encouraging that another ashpit, shown in the drawing above, was lined with B&W Refractory Castable "A". In this installation the two opposing high velocity water sprays cut refractories life two ways. First, water splattered on the hot walls (about 1800F) caused spalling. Second, the high velocity water jets had an abrasive effect on the floor refractories.

Here's the report: "After 20½ months service, B&W's Castable "A" lining was still in excellent condition—far superior to the refractories used before."

On the basis of these trials three other boiler ashpits have been lined with this 2600 degree castable.

In addition to ashpit linings, B&W Refractory Castable "A" is widely used in boilers for baffles, hearths, door linings, special shapes, repairing eroded brickwork and forming pier walls in stoker-fired boilers.

B&W Castable "A" is only one of a line of B&W Refractory Concretes which cost-conscious boiler operators are putting to increasing use in many different applications. These B&W Concretes may help you cut installation costs and lengthen furnace life. Consult your B&W Field Engineer.

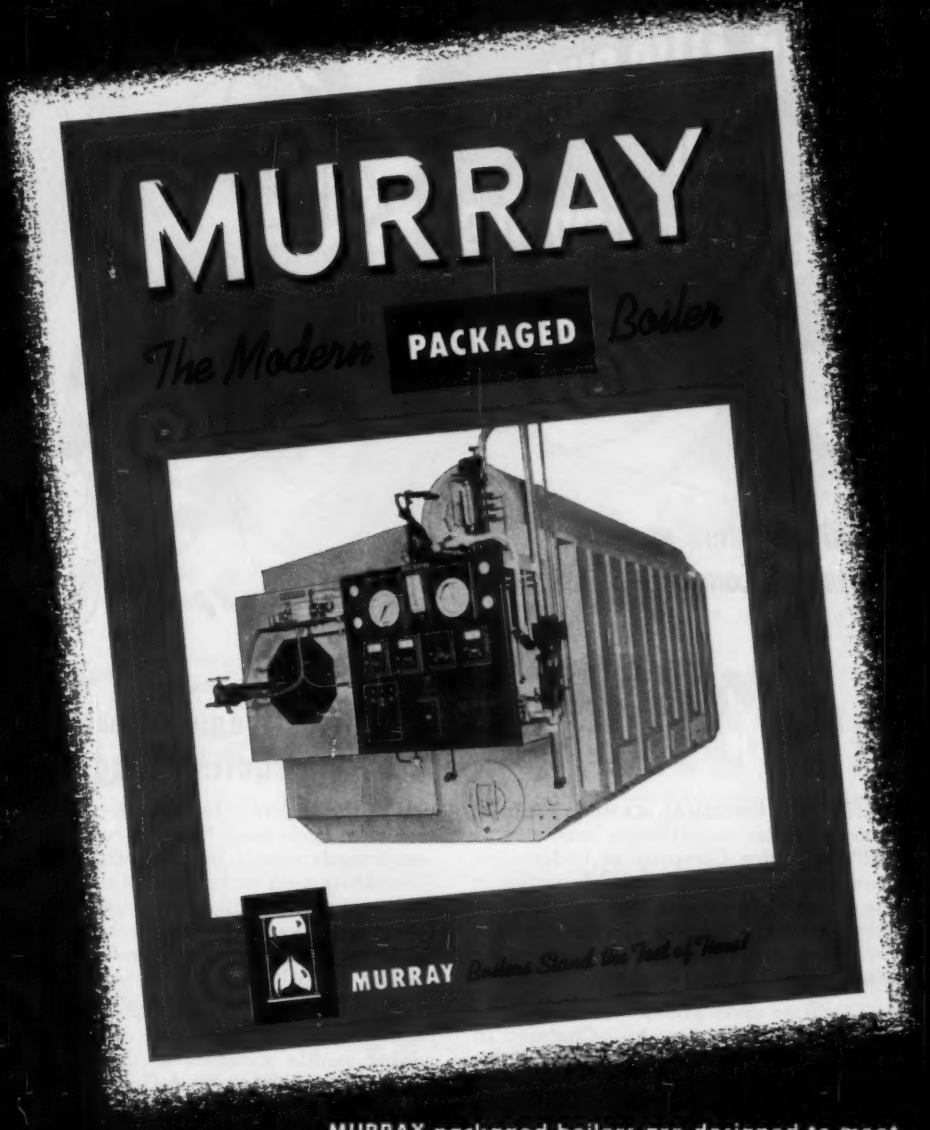
BABCOCK & WILCOX

THE BABCOCK & WILCOX CO.
REFRACTORIES DIVISION
GENERAL OFFICES: 161 EAST 42nd ST., NEW YORK 17, N.Y.
WORKS: AUGUSTA, GA.

B&W REFRACTORIES PRODUCTS — B&W Allmul Firebrick • B&W 80 Firebrick • B&W Junior Firebrick • B&W Insulating Firebrick B&W Refractory Castables, Plastics and Mortars • OTHER B&W PRODUCTS—Stationary & Marine Boilers and Component Equipment... Chemical Recovery Units . . . Seamless & Welded Tubes . . . Pulverizers . . . Fuel Burning Equipment . . . Pressure Vessels . . . Alloy Castings

R470A

Dependability with Economy!



MURRAY packaged boilers are designed to meet today's need for compact, low cost, reliable heating and generating plants . . . When you install a MURRAY packaged boiler, you get the benefit of over 85 year's experience exclusively in the manufacture of boilers and allied products . . . Write for new folder, "MURRAY, The Modern Packaged Boiler," which gives complete information.

MURRAY IRON WORKS COMPANY · BURLINGTON, IOWA

How Zeolite System at Public Service Company of Colorado

"Irons Out"

Water Irregularities Caused by Fluctuating Loads

DENVER'S UNUSUAL CLIMATE causes unusual water conditioning problems at Public Service Company of Colorado's Zuni Station. Steam from this station is used to heat downtown Denver buildings. Denver's balmy midday climate — except in the two cold months of the year—is the cause of troublesome load fluctuations.

The lime-soda-phosphate system installed in this plant by Allis-Chalmers in 1949 was one of the most modern in the country at the time. It is ideal for extremely high loads in the morning and evening, but requires careful adjustment to handle the low loads around noon.

Public Service of Colorado has decided to modernize to take advantage of developments in "hot lime–hot zeolite" systems since the original installation. The zeolite part of the system acts as its own corrective when loads drop, "ironing out" hardness irregularities in the lime effluent and eliminating need for manual adjustments. The new system will provide more consistent operation and lower hardness. The only chemicals needed are lime and salt, holding operating costs to a minimum.

The changeover, being handled completely by Allis-Chalmers, consists of adding zeolite softeners to the original equipment furnished by A-C.

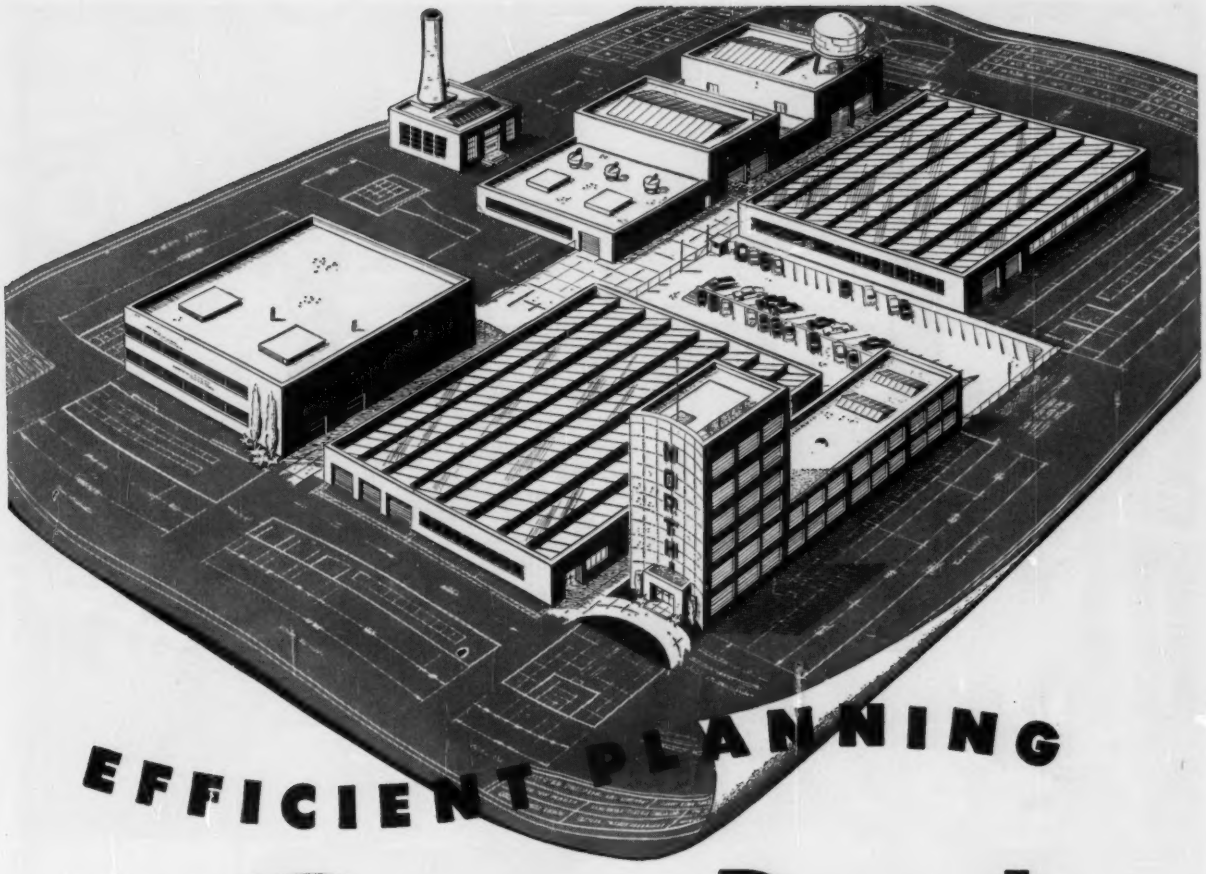
Next time you have a water problem — or want to consider modernization — take advantage of Allis-Chalmers water conditioning experience. For information, call the A-C office nearest you or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

WATER CONDITIONING—CHEMICALS, EQUIPMENT, SERVICE—FOR OVER 25 YEARS

A-C ALLIS-CHALMERS

A-4846



EFFICIENT PLANNING

Starts with RIC-WIL

● Early planning with a RIC-WIL field representative on central heating or air conditioning systems will mean less work later on. Custom engineering and prefabrication of RIC-WIL units offer quick, efficient installation. RIC-WIL's engineering service with forty-five years experience in the Insulated Piping Field is available for *early* planning and consultation.

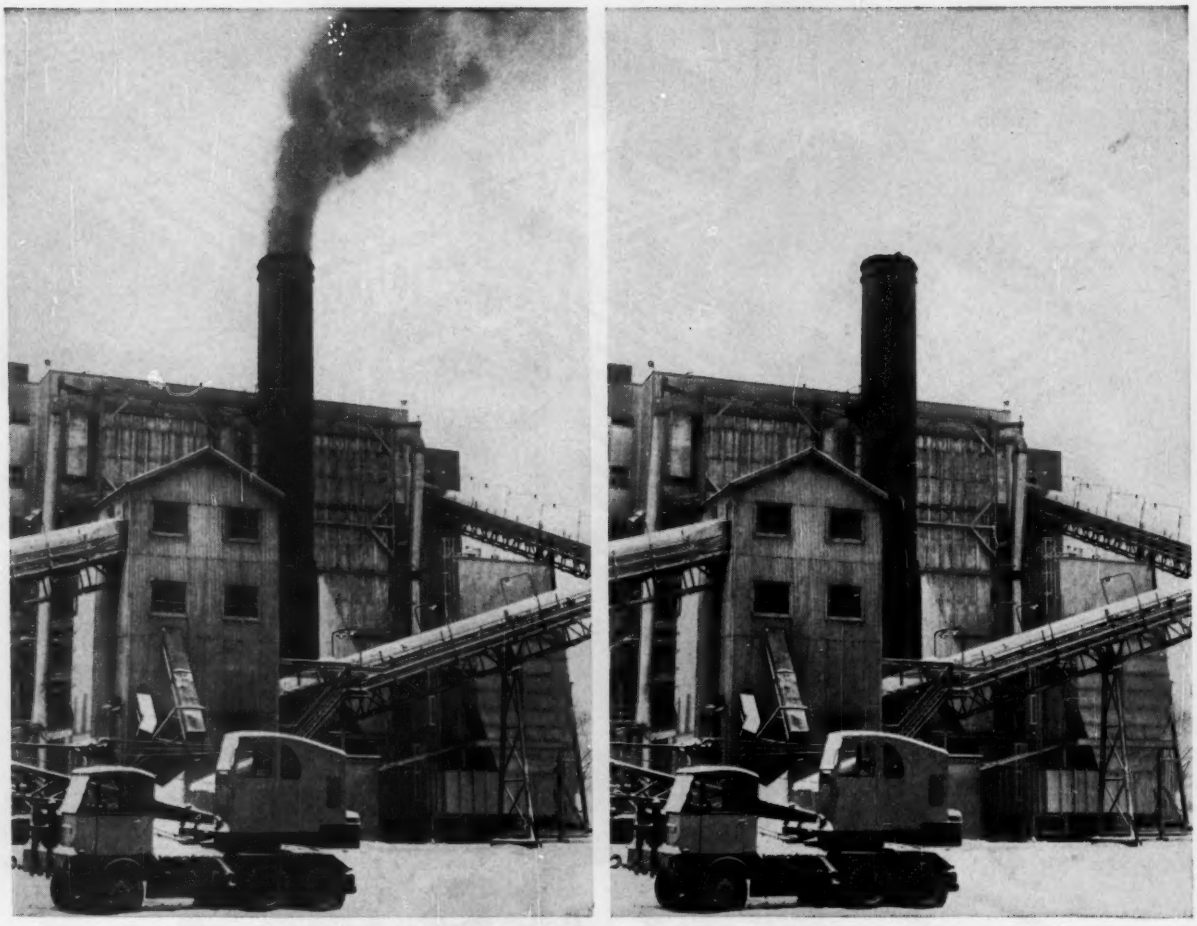
Write or phone your nearest representative or send for the illustrated RIC-WIL catalog.

Quality Piping Systems of the . . .
. . . Highest Thermal Efficiency

RIC-WIL INCORPORATED

PREFABRICATED INSULATED PIPING SYSTEMS

BARBERTON, OHIO



Fly Ash Problem Solved By Central Station

This Pennsylvania utility felt that as long as you can *see* dirty stack discharge, you have a problem. To solve it, they decided to insist on fly ash collection equipment with very high efficiency.

The electrical precipitators they chose, which were placed after existing mechanical collectors, are Cottrells, designed and built by Research-Cottrell. Their effectiveness is demonstrated in the above unretouched photographs. At the left, the precipitators were turned off long enough to take the picture showing the volume of fly ash discharged by the boilers. At the right, the precipitators are turned back on. Stack discharge is visually clean.

This is another example of industry's trend toward establishing its own higher standards for nuisance abatement. Research-Cottrell, which has made more fly ash installations than any other company, cites the following comparison:

In the period from 1923 to 1939 only 11% of its power plant customers specified fly ash collection efficiency of 95 to 98%. In recent years, that 11% has risen to fully 90%.

One reason, of course, is the generally increasing emphasis on community relations. Another factor is that far-sighted companies are anticipating stricter smoke regulations. They are anxious to install equipment that will end their smoke problems now and also prevent such problems from occurring in the future.

Still another factor is this. In recent years, with modern coal pulverization and advanced boiler design, there has been an increase in the fineness of fly ash particles. This calls for the most efficient equipment available.

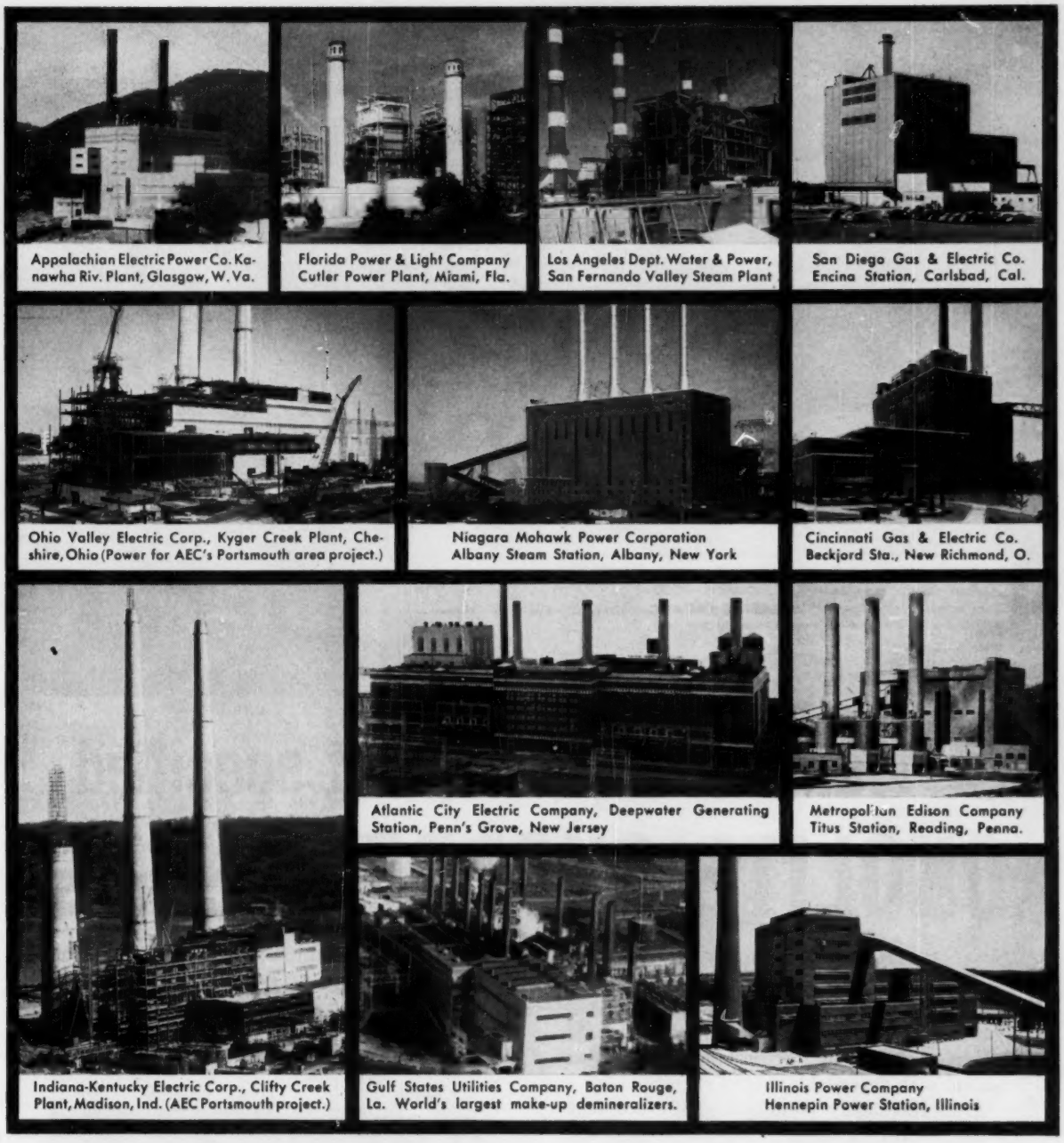
Read—in Bulletins FA and MI—about Cottrell equipment and the Research-Cottrell's MI Rapper. This device eliminates rapping puffs and enables the precipitator to maintain, continuously, its high collection efficiency. Write for your copies today.

RC-183

RESEARCH-COTTRELL, INC.

A WHOLLY OWNED SUBSIDIARY OF RESEARCH CORPORATION

Main Office and Plant: Bound Brook, N. J.
405 Lexington Ave., New York 17, N. Y. • Grant Building, Pittsburgh 19, Pa.
228 N. La Salle St., Chicago 1, Ill. • 111 Sutter St., San Francisco 4, Cal.



Appalachian Electric Power Co. Kanawha Riv. Plant, Glasgow, W. Va.

Florida Power & Light Company Cutler Power Plant, Miami, Fla.

Los Angeles Dept. Water & Power, San Fernando Valley Steam Plant

San Diego Gas & Electric Co. Encina Station, Carlsbad, Cal.

Ohio Valley Electric Corp., Kyger Creek Plant, Cheshire, Ohio (Power for AEC's Portsmouth area project.)

Niagara Mohawk Power Corporation Albany Steam Station, Albany, New York

Cincinnati Gas & Electric Co. Beckjord Sta., New Richmond, O.

Indiana-Kentucky Electric Corp., Clifty Creek Plant, Madison, Ind. (AEC Portsmouth project.)

Atlantic City Electric Company, Deepwater Generating Station, Penn's Grove, New Jersey

Metropolitan Edison Company Titus Station, Reading, Penna.

Gulf States Utilities Company, Baton Rouge, La. World's largest make-up demineralizers.

Illinois Power Company Hennepin Power Station, Illinois

Why these power plants chose PERMUTIT® *water conditioning:*

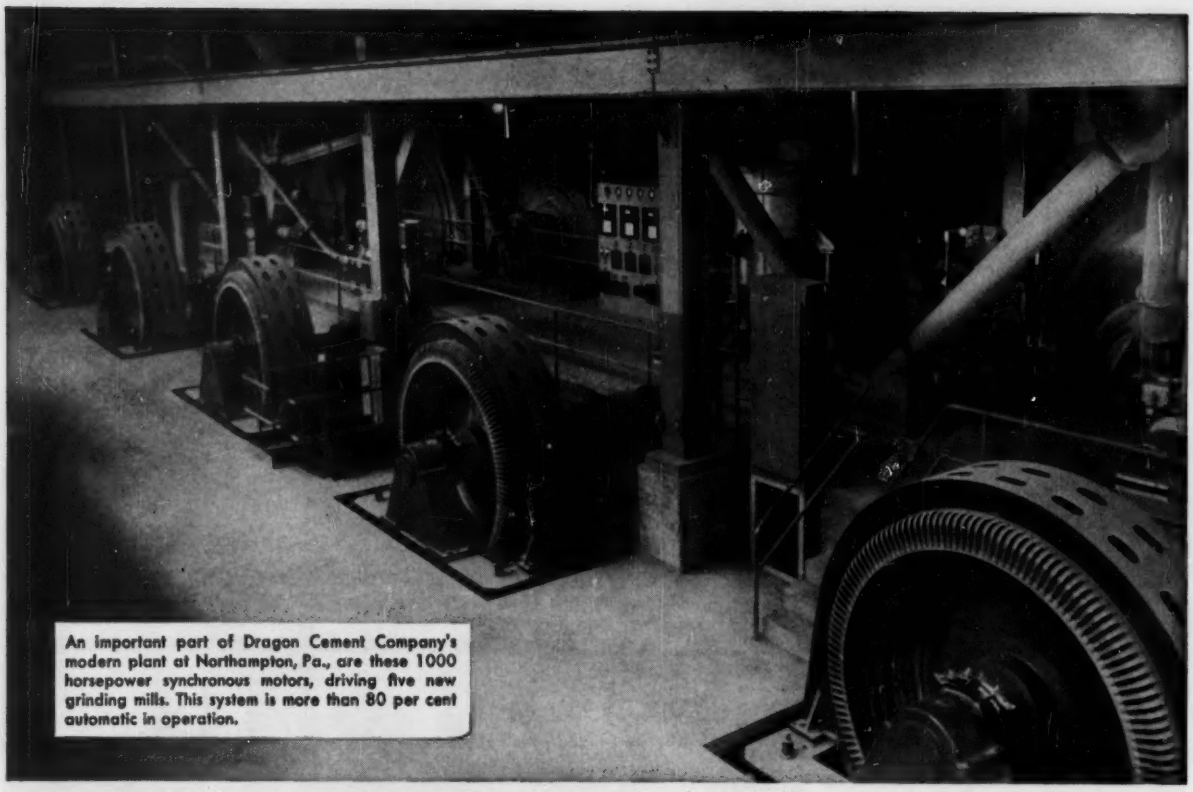
Some chose Permutit for its world-known engineering experience in thousands of utilities and industrial power plants . . . covering every major development in water conditioning from the first zeolite water softeners to the most modern demineralizing systems.

Others chose Permutit for its complete, integrated service: the water-analysis labs, engineering, equipment, controls and ion exchange resins . . . from one source . . . under one responsibility.

But most of the designers of these plants chose Permutit because they have personal knowledge of many installations where Permutit equipment has given long years of efficient, trouble-free performance. They know that's what pays off in the long run.

The Permutit Company, Dept. P-1, 330 West 42nd St., New York 36, N. Y.

DEMINERALIZERS • ZEOLITE AND HOT PROCESS SOFTENERS • PRECIPITATORS • DEAERATING HEATERS • PRESSURE AND GRAVITY FILTERS • CHEMICAL FEEDERS • AERATORS • BLOW-OFF EQUIPMENT AND OTHER POWER PLANT SPECIALTIES.



An important part of Dragon Cement Company's modern plant at Northampton, Pa., are these 1000 horsepower synchronous motors, driving five new grinding mills. This system is more than 80 per cent automatic in operation.

80% automatic, this plant specified OKOLITE-OKOPRENE cables

Since Dragon Cement Company's new mill was to represent the latest developments in cement making techniques, process control and automation were given the greatest consideration. This necessitated a reliable electrical power distribution system with dependable control circuits.

After thoroughly investigating the neoprene-jacketed wire field, they selected Okolite-Okoprene. In their new mill installation, 70 miles of cable were used for control circuits, and 25 miles for power distribution—all Okolite-Okoprene.

Dragon Cement Company is following a nation-wide trend of manufacturers to Okolite-Okoprene cables for circuits that must not fail. Okolite oil-base insulation, made from natural wild up-river Fine Para rubber, is moisture-, ozone-, and heat-resistant. The Okoprene sheath gives maximum protection from most harmful acids, oils and chemicals. In addition, because Okoprene's high surface resistivity prevents heavy longitudinal drainage currents, these cables are used in many

utility and industrial plants *unshielded* up to 5000 volts. When you order cable for circuits that must not fail, specify Okolite-Okoprene. Write for our new Bulletin PW-1085 for full details. The Okonite Company, Passaic, N. J.

OKONITE SINCE 1878 *insulated cables*

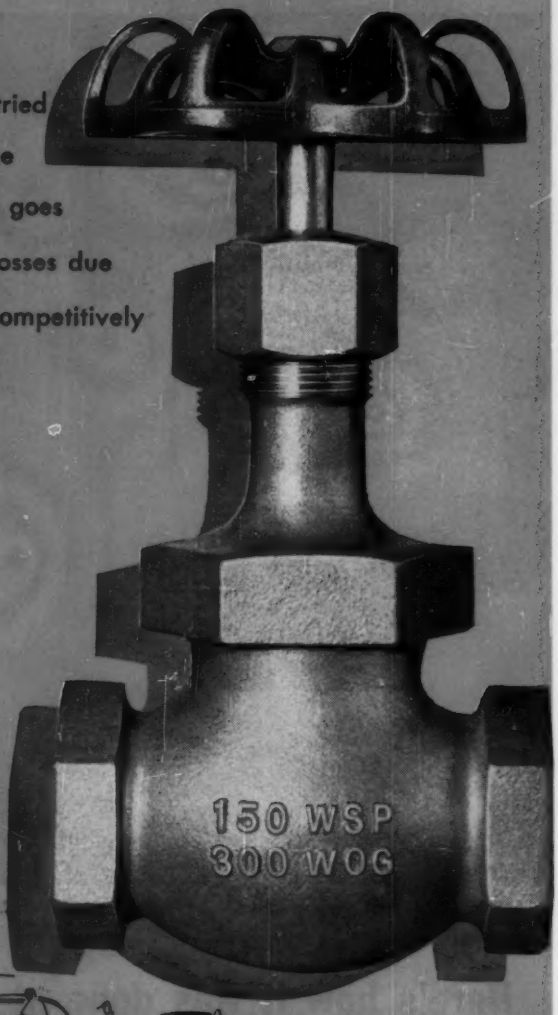
2947

END THOSE VALVE TROUBLES . . . NOW!

Are bronze valves a source of trouble in your maintenance program? Then you haven't tried O-B valves. Put them in your plant. Watch the maintenance job get easier as O-B quality goes to work. Notice the drop in production time losses due to valve troubles. O-B bronze valves are competitively priced. Ask your distributor about them.

Ohio Brass

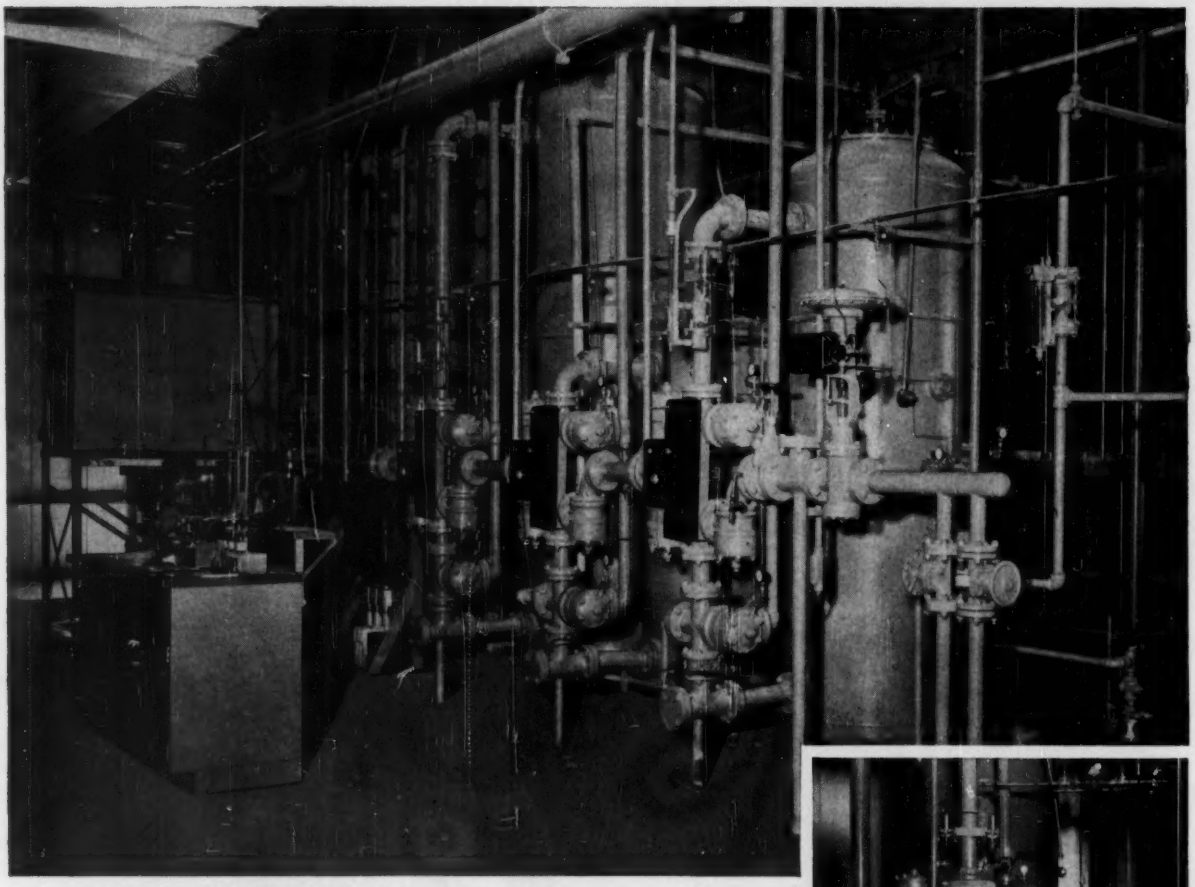
MANSFIELD (B) OHIO, U. S. A.



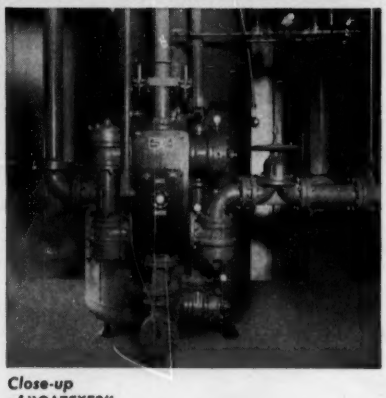
4615-V

O-B VALVES

INFILCO improved demineralization reduces feedwater costs 35%!



INFILCO Demineralization Plant installed at the North Omaha Station.



Close-up of "CATEXER" ion exchange unit.

Here's how it was done at Omaha –

Omaha Public Power District's source of feedwater make-up for 1500 p.s.i. boilers is the Missouri River. This water has high and extremely variable mineral content. Their previous experiences with two-bed demineralization plants indicated that the average chemical cost per 1,000 gallons of treated water would be approximately 40¢.

In considering the water treating requirements of the new North Omaha Station, INFILCO Engineers suggested a new type, four-bed demineralization plant. This suggestion was accepted and actual operations have shown the chemical costs have averaged 26¢ per 1,000 gallons—a saving of 14¢ over the original estimates. In addition, this *fully-automatic* plant initiates regeneration when required, regardless of variations in raw water mineral content, without sacrificing treated water quality.

If you have a high pressure boiler feedwater problem, CATEXER® ANEXER® Demineralization Plants are sure to offer an economical solution. Write for information or see your Consulting Engineer.

INFILCO INC. 917 South Campbell Ave., Tucson, Arizona
Field offices in principal cities in North America 5525

INFILCO

The one company offering engineered equipment for all types of water and waste processing—coagulation, precipitation, sedimentation, flotation, filtration, ion exchange and biological treatment.

New Money-Saving Airpower Anywhere in the Plant

Compact... Lightweight... Air Cooled

Le Roi Stationary Compressors are easily installed... anywhere

Take full advantage of every space in your plant where the economies of airpower can increase production and lower costs. How? By using Le Roi's two-stage, air-cooled stationary compressors that require a minimum of space, and are easy to install.

They're compact and lightweight. Moreover, these Le Roi compressors require no cooling water, eliminating the need for expensive space-eating pipes. There's no danger of freeze-ups or overheating from lack of liquid coolants. Only minimum attention by an operator is needed.

The new three cylinder 50S2, and six cylinder 75S2 and 100S2 compressors are balance-designed, reducing vibration and noise to a minimum. Available in 50, 75, and 100-hp sizes producing 210, 340, and 450-cfm capacities at 125 lbs. pressure, these new Le Roi airpower units offer low-cost operation, low-cost installation, and low-cost maintenance advantages for a wide range of needs.

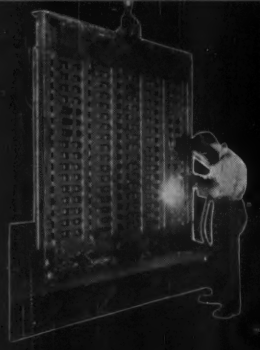
For years Westinghouse compressors were the national favorite in the ½ to 40-hp size range. With the three new Le Roi sizes, an even greater range of dependable airpower is yours — up to 100 hp.

Write today for complete literature describing Le Roi's dependable, low-cost air supply.

LE ROI Division of Westinghouse Air Brake Co.

MILWAUKEE 1, WISCONSIN

Distributors in all principal cities



WELDING SOLVES ANOTHER WEIGHT PROBLEM

(and USS "T-1" Steel solves the welding problem!)

Bedplates for modern color-printing presses have to be rugged—but as lightweight as possible. They must withstand constant pounding from printing rollers and cutting knives. And, since they move back and forth continually, they've got to be lightweight for fast, efficient operation. It is a good place to use a welded assembly of steel plate.

But that's where Graver Tank & Manufacturing Co., Inc., ran head-on into a tough fabrication problem. Alloy steel with the necessary strength and durability was difficult to weld. And with 534 welds to make on *every* bedplate, this was a king-size headache.

NO MORE HEADACHE!

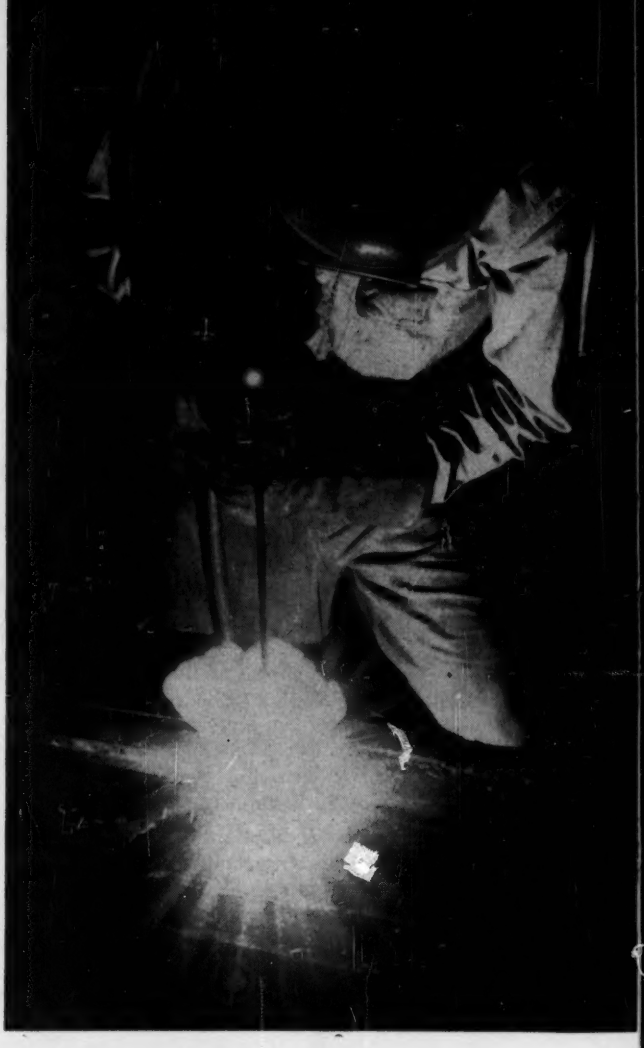
Now the headache is gone. Production costs are down. And the finished bedplates are working hard and long . . . taking a tremendous daily pounding without distortion.

The solution? Just a switch to a remarkable *new* alloy steel, USS "T-1" Steel.

"'T-1' Steel is very strong. Very tough. Able to take vicious impact abuse. Yet, it's easy to weld," says Mr. H. McDonald, Superintendent at Graver.

HOW ABOUT YOU?

If you have tough jobs, rugged jobs, where you want to weld your way to lower costs, give this new steel a try. We think you, like Mr. McDonald, will find it the best thing you have ever used. Right now, "T-1" is in service and doing well in bridges, power shovels, steam turbines, electrical transformer tanks, flywheels, pressure vessels, mine cars, and lots of other places. Write for details. United States Steel, Room 5085, Pittsburgh 30, Pa.



"TOP QUALITY" That's how Graver Tank & Manufacturing Co., Inc., East Chicago, Indiana, describes new USS "T-1" Steel. It gives them a yield strength of 90,000 psi . . . exceptional resistance to impact abuse . . . and good weldability. It enables them to build extremely rugged, all-welded bedplates for printing presses.

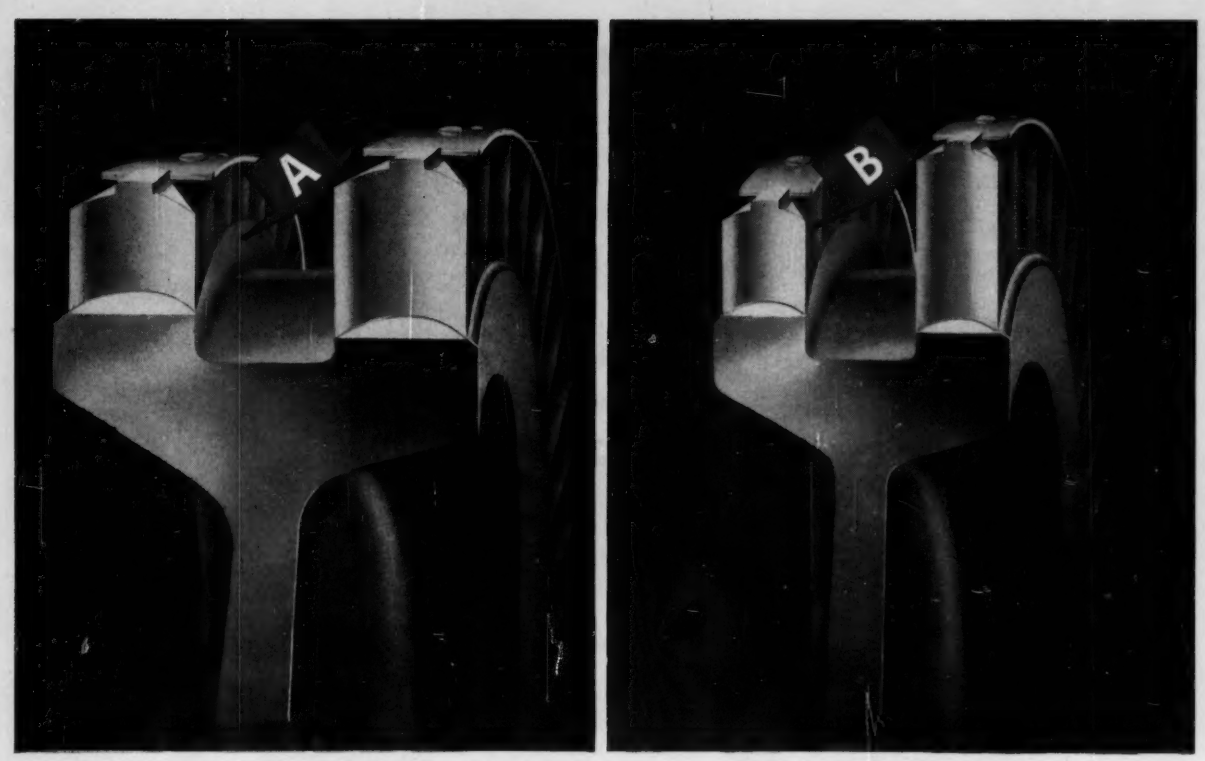
UNITED STATES STEEL CORPORATION, PITTSBURGH • COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO
TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA. • UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS, COAST-TO-COAST
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS "T-1" CONSTRUCTIONAL ALLOY STEEL

USS

6-15

UNITED STATES STEEL



(Left, A) wide bucket "L" type wheel. (Right, B) regular type wheel for Coppus Steam Turbines

Now...for low steam consumption – **COPPUS TURBINES** *can be furnished with wide bucket "L" type wheel*

Good news for steam turbine users where low steam consumption is important!

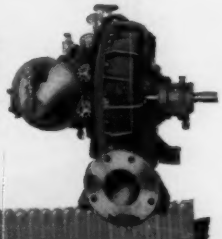
The Coppus Type "L" Wheel is the answer to this problem. Larger turbine buckets are employed to make the most economical use of steam.

In every respect the Coppus Turbine offers the top-quality features and advantages that have made the Coppus line outstanding for efficiency and economy. For example:

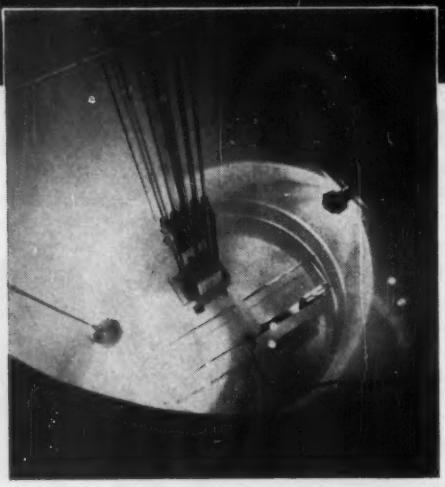
- Turbines rated close to your exact hp requirements, from 150 hp down to fractional. No need to buy a bigger, costlier turbine than your conditions call for.
- A larger number of steam nozzles, controlled individually by manually operated valves.
- Exclusive pilot operated excess speed safety trip supplementing constant speed governor.
- Replaceable cartridge type bearing housings.
- Optional carbon ring packing glands.

Coppus Steam Turbines ranging from 150 hp down to fractional, in 6 frame sizes, *make turbine dollars go farther.* Send for Bulletin 135 on Coppus Turbine.

COPPUS ENGINEERING CORPORATION
161 Park Avenue
Worcester 2, Mass.
Sales offices in
THOMAS' REGISTER



COPPUS "BLUE RIBBON" TURBINES



Here's what the onlooker sees when he gazes down into the Reactor's 20-ft deep "swimming pool." (Both photos courtesy U. S. A.E.C. and Union Carbide And Carbon Corp.)

Prominent among United States exhibits at the recent "Atoms for Peace" Conference, in Geneva, Switzerland, was the Research Reactor shown above. Like other research and proto-type power-producing reactors in this country and abroad, this Reactor incorporates Leeds & Northrup nuclear instrumentation. The five Speedomax recorders, in the main control panel, chart all control functions, while the L&N Servo Amplifier and Micro-micro-ammeter automatically control the Reactor when it operates at full power level.

Leeds & Northrup Company is staffed and equipped to service all of your reactor control requirements. Send for our brochure, "Control Systems for Nuclear Reactors." The address—Leeds & Northrup Co., 4910 Stenton Ave., Phila. 44, Pa.

LEEDS & NORTHRUP
instruments • automatic controls • furnaces

MOTORITE
Cut Gaskets
STRONGLY WOVEN for HEAVY DUTY JOBS

Anchor's MOTORITE red and black sheet consists of high quality asbestos yarn . . . a strongly woven gasket sheet reinforced with fine brass wire twisted into each yarn and woven into sheet form with close weave. To give this gasket material further resistance to hard wear, it is treated with a high heat-resisting compound, one side graphited to allow the joint to be broken without gasket adhesion.

Style 406 MOTORITE is widely used for automobile motor flange joints, for superheat steam gaskets, and especially useful for manifold gaskets in internal combustion engines. Likewise it is excellent on cylinder heads and steam hammers.

We invite you to write us your requirements today, or request special details.

DISTRICT OFFICES

BALTIMORE, MD.
BOSTON, MASS.
BUFFALO, N.Y.
CINCINNATI, OHIO
CHICAGO, ILL.
CLEVELAND, OHIO
DAYTON, OHIO
DETROIT, MICH.
HOUSTON, TEX.
INDIANAPOLIS, IND.
LOS ANGELES, CAL.
MILWAUKEE, WIS.
MONTREAL, CANADA
NEW ORLEANS, LA.
NEW YORK, N.Y.
PHILADELPHIA, PA.
PITTSBURGH, PA.
SAN FRANCISCO, CAL.
SEATTLE, WASH.
SPOKANE, WASH.
ST. LOUIS, MO.
TOLEDO, OHIO
WILMINGTON, CAL.

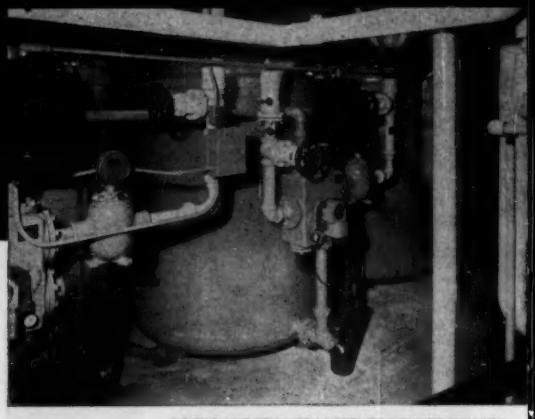
THE ANCHOR PACKING COMPANY

GENERAL OFFICES: PHILADELPHIA, PA.
FACTORIES: MANHEIM, PA. ELKHART, IND. MONTREAL, CAN.

FIBROUS AND METALLIC PACKINGS FOR EVERY INDUSTRIAL PURPOSE

problems in water conditioning...

SIMPLIFIED CONTROL



COCHRANE ZEOLITE SOFTENER DELIVERS WATER of zero hardness by the soap test. All commonly known zeolites—greensand, synthetic gel, sulfonated coal and the various styrene medium capacity resins are available for most practical individual application. Units can be adapted for automatic operation. Three 6' x 6' fully automatic Cochrane Zeolite Softeners above provide a capacity of 288,000 lbs. per hr.

Cochrane

Hydromatic Valve *assures* easy, accurate control of ion exchange equipment

Here is a valve so simple to operate that no knowledge of softening equipment or of the ion-exchange process is required!

The Cochrane Hydromatic Valve consists of an integrated nest of hydraulically-actuated diaphragm valves. Valves are so constructed that it is impossible for any of them to be out of position during operation. Compass point positions for four operating stations on the pilot reduce operating error—assure maximum delivery of high quality effluent without danger of contamination. "Drop tight" construction eliminates the possibility of scoring. Compact, easy to operate Hydromatic Valve is designed for years of dependable operation. Write for Bulletin 4520-B.

The Cochrane Corporation designs and manufactures complete lines of deaeration, precipitation, ion exchange, and water conditioning equipment . . . Consult Cochrane First!

COCHRANE CORPORATION — WATER AND HEAT ENGINEERS SINCE 1863 — PHILADELPHIA

Cochrane CORPORATION

Representatives in 30 principal cities in U.S.; Toronto, Canada; Paris, France; La Spezia, Italy; Mexico City, Mexico; Havana, Cuba; Caracas, Venezuela; San Juan, Puerto Rico; Honolulu, Hawaii.
Pottstown Metal Products Division—Custom built carbon steel and alloy products

3106 N. 17TH STREET, PHILADELPHIA 32, PA.
NEW YORK • PHILADELPHIA • CHICAGO

Demineralizers • Hot Process Softeners • Hot Zeolite Softeners • Dealkalizers • Reactors • Deaerators • Continuous Blowoff Systems • Condens Return Systems • Specialties

New Year 1956

SOME TIME AGO, my good friend Joe Bennett of American Engineering Company sent me a booklet reviewing the 100-year history of L & C Steinmueller of Gummersbach, Germany. This firm is familiar to many power men as one of the largest boiler and stoker companies in Europe.

I didn't get around to reading this booklet until recently. When I did, I ran across some interesting points that seem particularly appropriate now, at the New Year season.

This company is unique in having been owned by the Steinmueller family since its beginning a century ago. Grandfather Steinmueller was a musician and like many musicians found it difficult to make a living for his family. So he started a paper mill but insisted that his children, and future generations, must study music to learn harmony.

The first boiler bought for the paper mill gave so much trouble the Steinmuellers redesigned it. So successful was this redesign that they found themselves in the boiler business and this has been their main interest ever since.

Here was an unusual start, but what really interested me in this story was the way the family set themselves a code of behavior that has been conscientiously followed ever since. Some of the items in this list of principles grapple directly with the peculiar problems of a family business. For example, each son or son-in-law entering the partnership must take an oath to put the business first—ahead of family and personal concerns.

Some of the precepts now have a quaint ring—members of the firm must never overeat. After a meal they should always feel they could still eat a slice of dry bread! And members of the firm should walk in the open air each day—discussing business problems as they do.

We can read such instructions with a smile for the all-too-human weaknesses they guard against. But some other elements of this century-old code of behavior could well be part of any good resolutions we power men make in this New Year season.

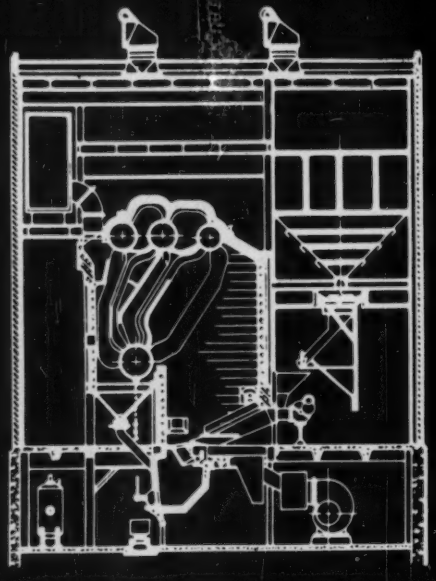
Here, in particular, are three injunctions that have guided successive generations of Steinmueller family partners:

1. Their pride must always be in the quality of the products and services they supply.
2. Where a question of quality or integrity is involved, they must always give satisfaction even though they receive no payment.
3. They must take an active role in and give part of their time to charitable organizations, to education and to community government.

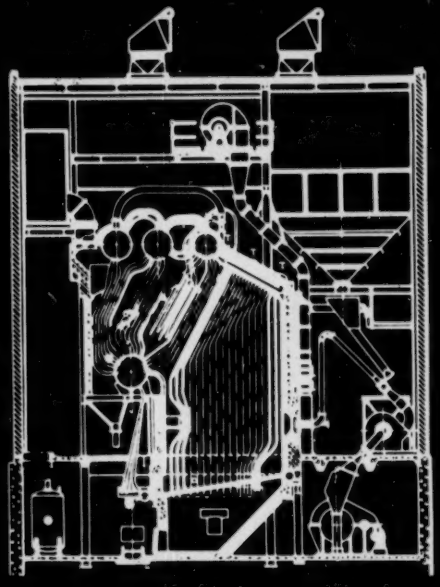
These concepts, simply stated and rigorously followed, have made for this family firm a 100-year record of honorable achievement. I commend them to you as thoughts for the New Year, along with my good wishes for your health and prosperity.

KENNEDY PULVERIZED

Will cut your coal costs! SAVINGS



BEFORE: Using premium coal on stokers



AFTER: Using low price coal through pulverize

Send for Literature

THESE ARE FEATURES OF THE KENNEDY PULVERIZED COAL FIRING SYSTEM . . .

FULLY AIR SWEPT

COAL PULVERIZED TO SUPERFINENESS

COAL COMPLETELY CARBURETED READY FOR COMBUSTION

BIG TRUNNIONS FOR AIR SWEEPING

BALLS ADDED WITHOUT SHUTTING DOWN

LOW OPERATING AND MAINTENANCE COSTS

UNBURNT CARBON LOSSES LESS THAN ½%

INSTANT RESPONSE TO CONTROLS

85% TO 90% THROUGH 200 MESH

20% MOISTURE REMOVED WHILE PULVERIZING

PULVERIZE ANY COAL
BITUMINOUS
ANTHRACITE
COKE BREEZE

TRAMP IRON ACTUALLY AIDS IN PULVERIZING

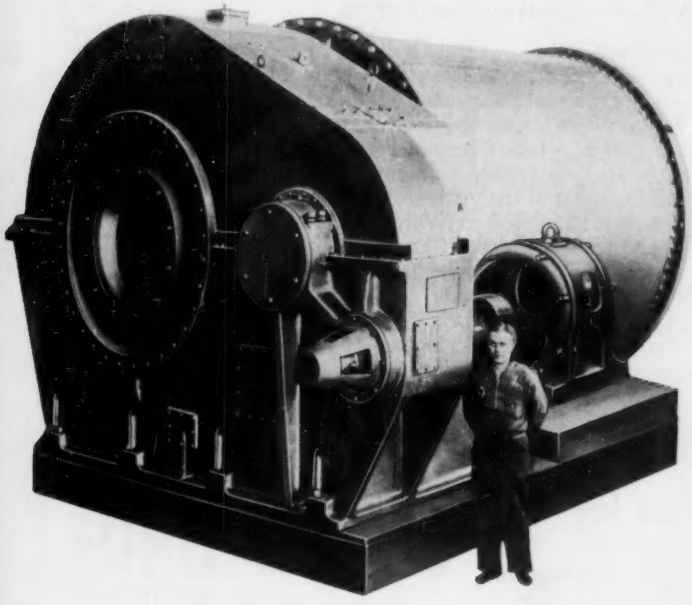
RESERVES OF FUEL FOR INSTANT RESPONSE TO STEAM DEMAND

IT COSTS LESS TO OWN THE BEST!

Are you profiting from All these advantages?

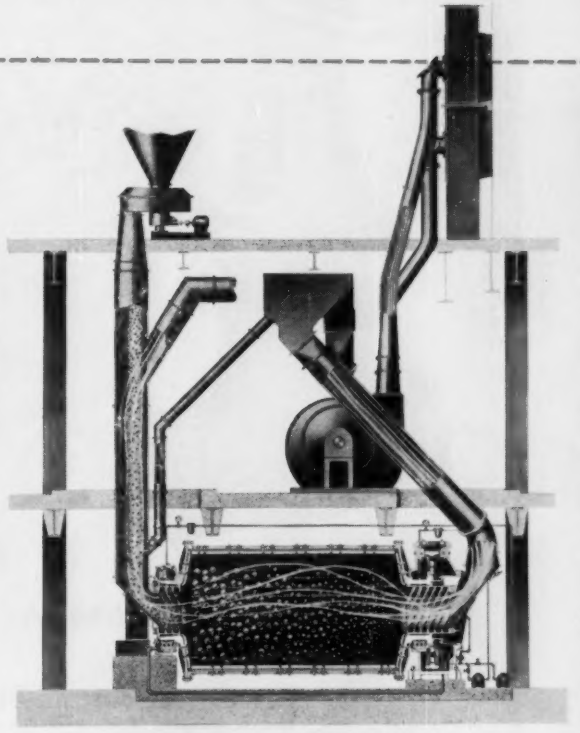
COAL FIRING SYSTEM...

up to $3.00 per ton can be effected!



AIR SWEPT TUBE MILL

Slow-speed ball mill for perfect pulverization by air separation. Low-cost grinding of all grades of coal regardless of hardness. Grinding balls can be added without shutting down. Continuous year-to-year operation with better than 99% availability. Complete designs for steam and coal installations.



COAL FIRING SYSTEM

Cutaway drawing of Kennedy Pulverized Coal Firing System showing disc feeder, pulverizer, classifier, exhauster, burner. Raw coal is delivered to disc feeder and fed into tube mill.

Whether you are modernizing your present plant or building a new one, it will *pay you* to consult a KVS engineer. He will show you operating data and give you *facts* about plants that are saving as much as $3.00 per ton on coal costs with KVS Pulverized Coal Firing Systems. These tremendous savings are effected through the use of low grade, low cost coal, pulverized to superfineness with instant response to combustion controls. The KVS Pulverized Coal Firing System provides maximum heat from every ton of coal. Consult KVS for "facts that count" in economical steam plant operation.

KENNEDY-VAN SAUN

MANUFACTURING & ENGINEERING CORPORATION

TWO PARK AVENUE, NEW YORK 16, N. Y. • FACTORY, DANVILLE, PENNSYLVANIA

COMPLETE LINES OF WALWORTH VALVES for POWER PLANT SERVICE

Featuring Walworth Pressure-Seal Valves

Here are cast steel valves built for high-pressure, high-temperature service. The unique bonnet-to-body design utilizes internal line pressure for a tight, leakproof connection. The higher the pressure the tighter the bonnet joint! Bulky, heavy bonnet flanges, bonnet studs, and nuts are completely eliminated providing a modern valve design of truly streamlined proportions. Maintenance is simplified as Walworth Pressure-Seal Valves are easily assembled, disassembled, and insulated.

Walworth Pressure-Seal Valves are available in Series 600, 900, 1500, 2500, and in a wide range of sizes and types. Complete information is available from your nearby Walworth Distributor—or—write Walworth for for a free copy of Circular 16.

and including these valves for "*'round-the-plant*" use!

WALWORTH SMALL CAST STEEL Y-GLOBE VALVES. Simplified design eliminates many of the problems encountered in high-temperature, high-pressure service. No bonnet joint. Improved back-seat design means longer life for packing rings.

WALWORTH LUBRICATED PLUG VALVES. Easy turning—quick operating. Lubricant can be renewed while the valve is in service. Lubricant completely surrounds the plug ports for a tight seal against leaks. Remember, always use Walworth Lubricant in Walworth Lubricated Plug Valves.

WALWORTH BRONZE VALVES. Standardized lines of bronze valves provide an unsurpassed system of interchangeability of parts, drastically reducing inventory problems. Walseal Valves with brazing ends also available in a variety of types.

WALWORTH IRON BODY GATE VALVES. Straight-flow port design reduces fluid turbulence to a practical minimum. Seat rings of end-seated type are screwed into the body. Brass liner on glands assures greater resistance to corrosion and scoring. Available with threaded or flanged ends.

WALWORTH CAST STEEL GATE VALVES. Bolted bonnet, wedge gate, OS&Y. Bonnets and bodies are engineered to withstand pressure and minimize distortion. Heavy steel walls provide extra strength and longer life. Deep stuffing boxes in all sizes (2" to 24") insure tightness and maximum packing life. Also available in globe and angle types.

WALWORTH also offers Plastic Valves, Fittings, *and* Pipe of polyvinyl chloride, moulded to Walworth's specifications by General American Transportation Company of B. F. Goodrich Chemical Company Geon!

WALWORTH

Manufacturers since 1842

valves . . . pipe fittings . . . pipe wrenches

60 East 42nd Street, New York 17, N. Y.

Walworth Company of Canada, Ltd., Toronto

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

B G A SKROTZKI
Associate Editor in Charge

FORD adapts the know-how of mass production to plant electrical-distribution design

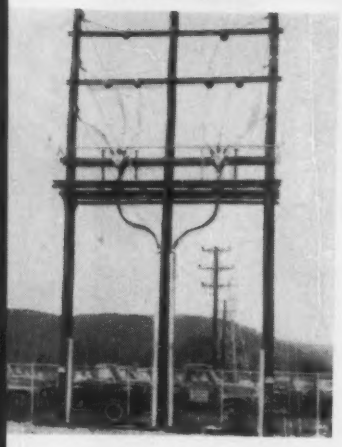
► As PART of a program costing over $2¼ billion, Ford Div of Ford Motor Co swung open the doors on three spanking-new assembly plants during 1955. Newest and largest lies sprawled alongside Route 17 in the small town of Mahwah, N. J. In San Jose, Calif. and Louisville, Ky. are Mahwah's companion plants—all three bearing a major sameness, electrically.

This sameness represents many years of effort by Ford's engineers to come up with an electrical-distribution scheme that would fully meet their high requirements for flexibility, low maintenance, sound engineering design. There is little startling about the type distribution as such. It's a simple secondary selective layout using double-ended units and askarel-filled transformers. The interest angle lies in the attention paid to practical detail in equipment specification and on-the-job installation—a parallel in many ways to Ford's mass-production techniques developed for automobile assembly.

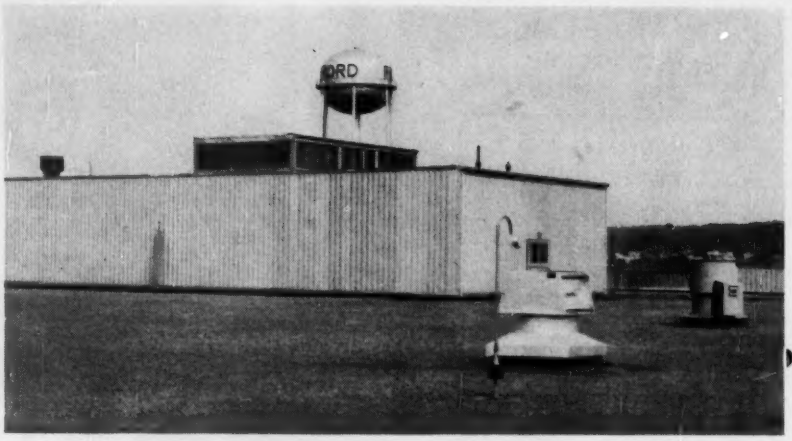
Substations are spotted on the roof, out of the way, yet quickly accessible. Buying voltage, 13.2 kv, is carried right up to secondary subs, eliminating a double transformation.

Lighting appears quite ordinary—96-in. slimlines. But they're all fed and suspended from 50-amp trolley duct laid out on 15-ft centers. Each fixture is fused.

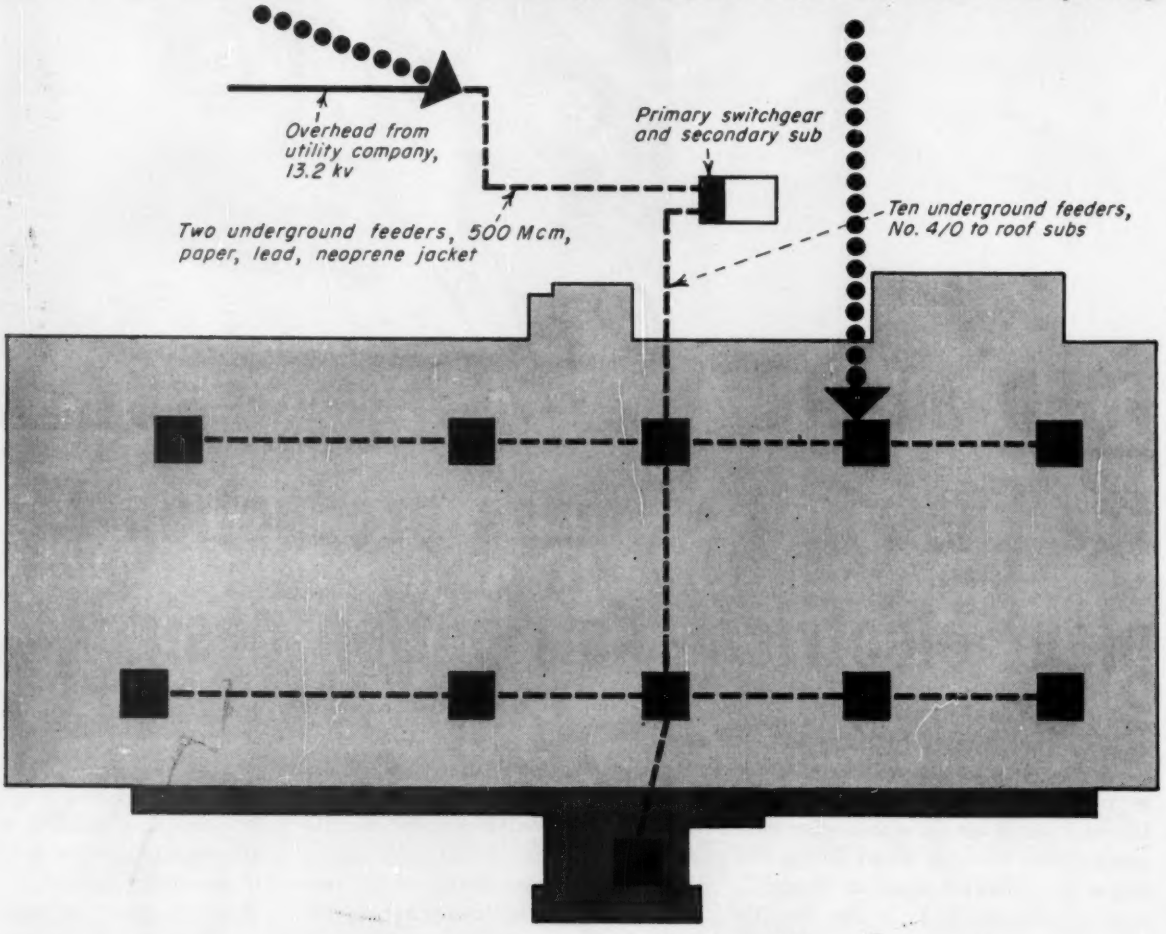
On the next four pages you'll find the high points of Ford's latest thinking on electrical distribution. Mull over them in the light of your next design.



Dual 13.2-kv feeders



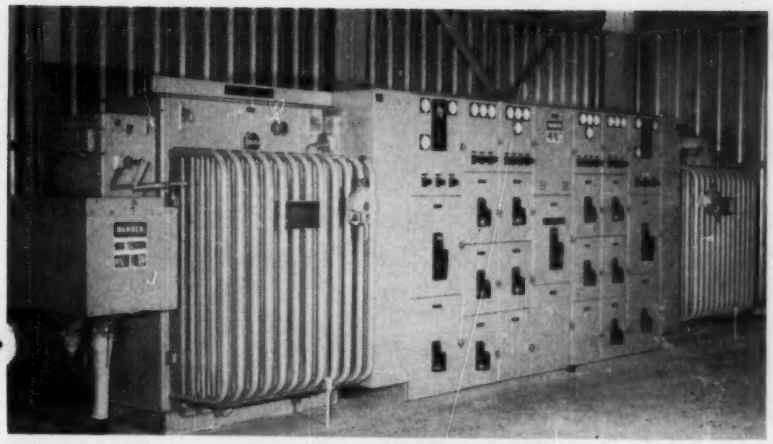
Roof subs funnel power to plant's 12,500-kva demand mainly through . . .


Overhead from utility company, 13.2 kv
Primary switchgear and secondary sub
Two underground feeders, 500 Mcm, paper, lead, neoprene jacket
Ten underground feeders, No. 4/0 to roof subs

In any plant designed for the Ford Motor Co. a set of standards and recommendations are handed the architect and engineer. These serve as the basis for design and the resultant plan and specs are woven around them: The standards and recommendations have proven themselves to the point where Ford can pretty much get a tailormade electrical distribution system, using the same basic pattern.

Typical key points of a modern Ford assembly plant, electrically: locating substations on roof plus the heavy use of flexible interlocked armored cable.

Primary distribution of a modern Ford plant is designed around need for top flexibility. Typical: Ford engineers found it impractical to select transformer capacity to fit but one layout. What they shoot for is a system that



. . . double-ended units and askarel transformers, totaling 25,500 kva

Present transformer capacity allows for 12 va per sq ft

accommodates maximum assembly-line rearrangements without changing the primary electrical scheme. They go a step farther: the distribution scheme can be rearranged readily with minimum cost should a major equipment shift become necessary.

Standardized approach to electrical-power distribution in Ford assembly plants was driven home in an AIEE paper describing the new San Jose, Calif. plant. The scheme outlined there by E Eriksrud of Ford and N A Kieb of Albert Kahn Associates (AIEE Summer General Meeting, Los Angeles, June 1954) is also basically the same for the Louisville, Ky. and Mahwah, N. J. plants. The Mahwah plant is newest and largest of the three so we'll outline in this article the design features in that plant.

Assembly building at Mahwah, N. J. is a steel-supported structure measuring about 800 by 2100 ft. Production people estimate 540 cars will roll out in an 8-hr work shift. Roof is built up from a metal deck, glass-fiber insulation, roofing felt finished off with asphalt and pea gravel. Roof is parallel to the concrete slab floor, both sloping 1 in. per 100 ft. Sloping the floor trimmed a sizable chunk off excavation costs; roof sloping aided drainage. Walls are precast concrete panels with tinted glass in aluminum sash. There are no skylights for venting or natural lighting. But the roof is dotted with small structures, housing supply and exhaust fans plus the individual steam heating units.

Primary feeder scheme starts at Rockland Electric's 33/13.2-kv substation, runs partly overhead and mostly underground, to the primary room in utility building. Here the twin feeders run into modern drawout-type metalclad switchgear, housing air circuit breakers rated 15-kv and 500,000-kva interrupting capacity. Leaving primary room, 13.2-kv feeders are laid underground to assembly building. Once there, they run up in conduit, alongside the structural columns, to the 12 substations spotted along the roof. Each sub measures 45x50 ft and is equipped with hatches to raise and lower equipment from assembly-building floor.

All assembly-building loads, except welding, are served by eight 2000-kva and two 1000-kva subs. Each such sub handles an area of about 400x425 ft, equaling a transformer capacity of about 12 va per sq ft. Air-compressor and pumping load in utility building (structure housing primary switchgear, steam boilers, air compressors, pumps) is handled from a 3000-kva transformer. A separate 3000-kva sub feeds welding load in assembly building.

Roof subs, stepping voltage down from 13.2 kv to 480 v, are mainly the in-line double-ended type having a transformer on each end and switchgear between. Transformers have a metal-enclosed askarel-filled disconnect switch on primary side and main breaker in secondary switchgear.

Askarel-filled switch is key-interlocked with secondary breaker, preventing operation under load. Primary switch in each sub has two potheads connected by bus within cubicle. This feature permits looping a feeder through the sub and on to the next.

Pothead design (that is, potheads connecting to askarel-filled switches) is an interesting feature. In years past, trouble was met with askarel dissolving sealing and gasketing materials where pothead was mounted at bottom of switch compartment, with bushing extending into fluid. Sometimes askarel leaked into the pothead, dissolving compound. Where cable insulation became saturated with askarel, power factor of cable was lowered, leading to eventual cable failure.

Today's specs for all Ford subs require an air-filled and well-drained metal enclosure between potheads and underside of switch. This design means leaking askarel can be detected before damaging pothead or cable.

Primary feeders to subs are 4/0 3-conductor PILC with neoprene jacket. Cables serve a transformer in each of two or three adjacent subs. Every sub is operated with secondary tie breaker normally open. Main and tie breakers are key-interlocked to prevent closing tie until one main feed is open.

This tie-breaker setup comes into play if a transformer or primary feeder fails. Load can be picked up on remaining transformer in bank by closing the tie breaker. This is a standard garden-variety secondary selective arrangement (POWER, Oct 1953, p 90). Depending on specific load being carried by energized transformer, nonessential load may be dropped before overload causes damage. It was with this thought in mind that every main and feeder breaker was provided with an ammeter and test block to indicate load carried. also to provide for portable recording instruments. Six spare breaker positions are allowed in each roof sub; three from each bus for load growth.

Secondary distribution is mainly through a plug-in bus-duct system. The 400-amp bus-duct scheme runs lengthwise and feeds assembly building utility motors, scattered production loads, concentrated conveyor loads to 100 hp. By locating duct runs on alternate trusses, resulting spacing is 100 ft between duct centers. Roof subs feed down to center of each duct section for area served. Eight breakers in each roof sub feed bus ducts.

Interlocked armored cable is used widely in Mahwah, Louisville, San Jose. Ford chose it over cable and conduit. Their experience showed interlocked cable relatively simple to install and

SLIMLINE INDUSTRIAL FIXTURES, with slotted porcelain-enamel reflectors and 2-tube 96-in. 4500-deg K tubes, are hung from and supplied by 50-amp trolley duct. Each fixture contains its own fuse to meet Code requirements since fixtures are tied direct to high-amperage duct. Trolley is fed at 120 v through narrow column-type lighting panels housing breakers

Main breaker in paint room connects to CO_2 system for automatic tripping

essentially maintenance-free. It pans out exceptionally well when a group of cables are run together on a common rack. At Mahwah, feeds to bus duct are 500 Mcm 3-conductor varnished-cambric interlocked armor, run in ladder-like aluminum racks through the trusses. Eight cables start out at sub, run together on rack, drop off a pair at a time to feed the plug-in duct.

There are a few tricks to installing interlocked cable that really trim cost. Typical trick: At Mahwah the racks were first installed along route cable was to follow. Next, cables were pulled in place. Large-diameter sheaves were spotted at turns; up to 1000 ft of cable pulled at one time. Even 12 cables can be laid in a single rack. After all cables were laid each was spaced, straightened, clamped to rack.

Loads over 100 hp are fed directly from separate breakers in substation. Individual roof units for venting and heating the assembly building are controlled through motor-control center in a roof sub. Typical control center is fed off a circuit breaker in substation switchgear. Down on the production floor, button control and pilot lights are the everyday control points for each roof unit.

Welding substation is positioned close to load, with three 1200-amp low-reactance ducts running out through trusses to the welders. Then to simplify connecting welding units, cable tap-boxes are placed on 20-ft centers along each run. Same primary feeders that feed assembly building subs feed the two 1500-kva transformers in welding sub.

Utility building houses four air compressors, driven by 450-hp synchronous motors. For heating and miscellaneous steam needs there are three 120,000-lb-per-hr boilers. A double-ended sub with two 1500-kva transformers nicely handles this load. Sub is set right in same room with the primary switchgear, separated structurally from rest of the building.

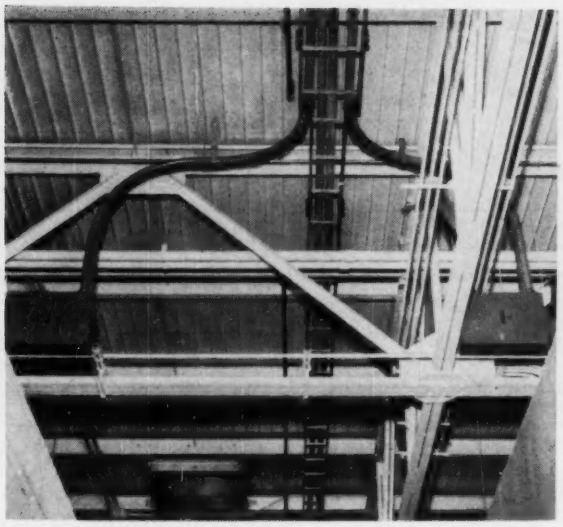
To avoid expense of explosionproof electrical equipment in the oil house, all major electrical equipment at that point is in an isolated room. Here there are two main switches and an automatic throwover to swing from the normal to standby feeders. An interesting safety feature is found in the paint room. Trip circuit of main circuit breaker feeding load to that area is hooked into the CO_2 fire-protection system. Now all electrical equipment in the room is de-energized in case a fire starts.

Lighting in the assembly building at Mahwah, San Jose and Louisville consists of 2-tube 96-in. slimline industrial fixtures with slotted porcelain-enamel reflectors, 4500-deg K tubes. Fixtures are hung from and fed by the 50-amp trolley duct which is on 15-ft centers. As per National Electrical Code requirements, each fixture has a fuse since each is tapped directly off a 50-amp trolley. This setup protects every fixture individually, isolating only the faulty unit rather than a complete section. With fixtures spaced on 10-ft centers along the trolley duct, a 30 ft-c lighting intensity is maintained. Trolley duct is fed at 120-v through narrow column-type lighting panels, using 50-amp single-pole circuit breakers. A dry-type lighting transformer hangs above each panel in the trusses, fed from plug-in bus duct system.

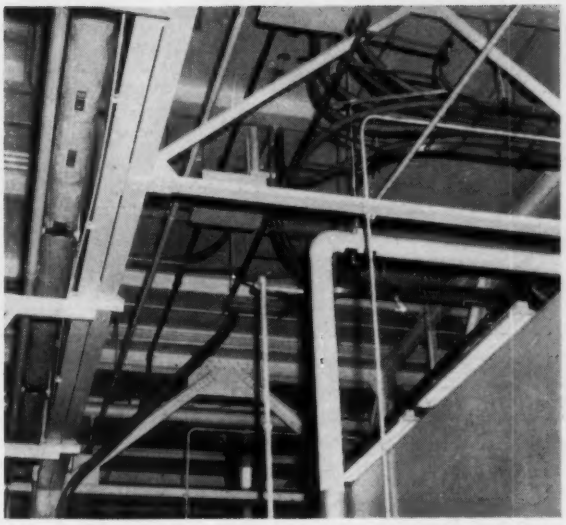
Future additions to the lighting system are provided by specifying that each lighting transformer have about 25% spare capacity. As shown in photo, facing page, supplementary lighting mounts along conveyor line to meet the seeing needs for particular tasks. Additional lighting transformers and panels take care of this type of local illumination.

Emergency lighting is well handled too. Battery-operated spots along passageways, equipped with trickle chargers and throw-over relays, provide minimum lighting for about two hours. Once power is restored the batteries are automatically recharged.

Administration building has louvered fluorescent fixtures, set in 4-ft rows, and arranged so partitions can be changed without relocating any lighting fixtures.



INTERLOCKED ARMORED CABLE is run in ladderlike aluminum racks through trusses. Cables are grouped at sub, run together, dropped off a pair at a time to feed duct sections



TOP FLEXIBILITY from using roof subs and armored cable. Changes are simple—with spare nipples in ceiling run into sub above. Bus ducts hang on alternate trusses, 100 ft apart

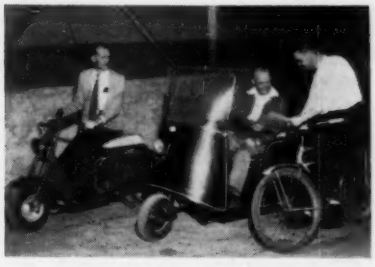
This latter feature holds true if the partitions are moved in 4-ft steps. These 2-tube lighting fixtures provide a minimum of 35 ft-c.

Over in the kitchen and cafeteria areas, tubes are deluxe-warm-white to avoid the unpleasant appearance of food when lighted with 4500-deg K tubes. Outside lighting around buildings' perimeter depends on 500-w enclosed floodlights mounted on about 80-ft centers. Control is through a central time switch with an astronomical dial placed in the plant-protection office.

Plant-protection setup includes a complete system of fire and watchman boxes, horns, alarms and a central desk with registers, time stamps, battery racks and similar features you might expect to find in a small city. Design of the low-voltage system is such that bells for code paging can be added later, when needed, with minimum trouble. The clock system utilizes high-frequency impulses from a master clock and program device, a technique similar to carrier current systems used by large utility companies. Time and indicating clocks, dismissal horns and bells are included. Once again, outlet boxes on well-planned regular centers provide for low-cost future revisions.

Lasting engineering impression after reviewing the electrical facilities in the Mahwah plant centers about the extent to which Ford engineers have gone to insure maximum use of installed equipment, with an experienced eye peeled for low-maintenance, future additions.

PLANT ENGINEERS solve many problems



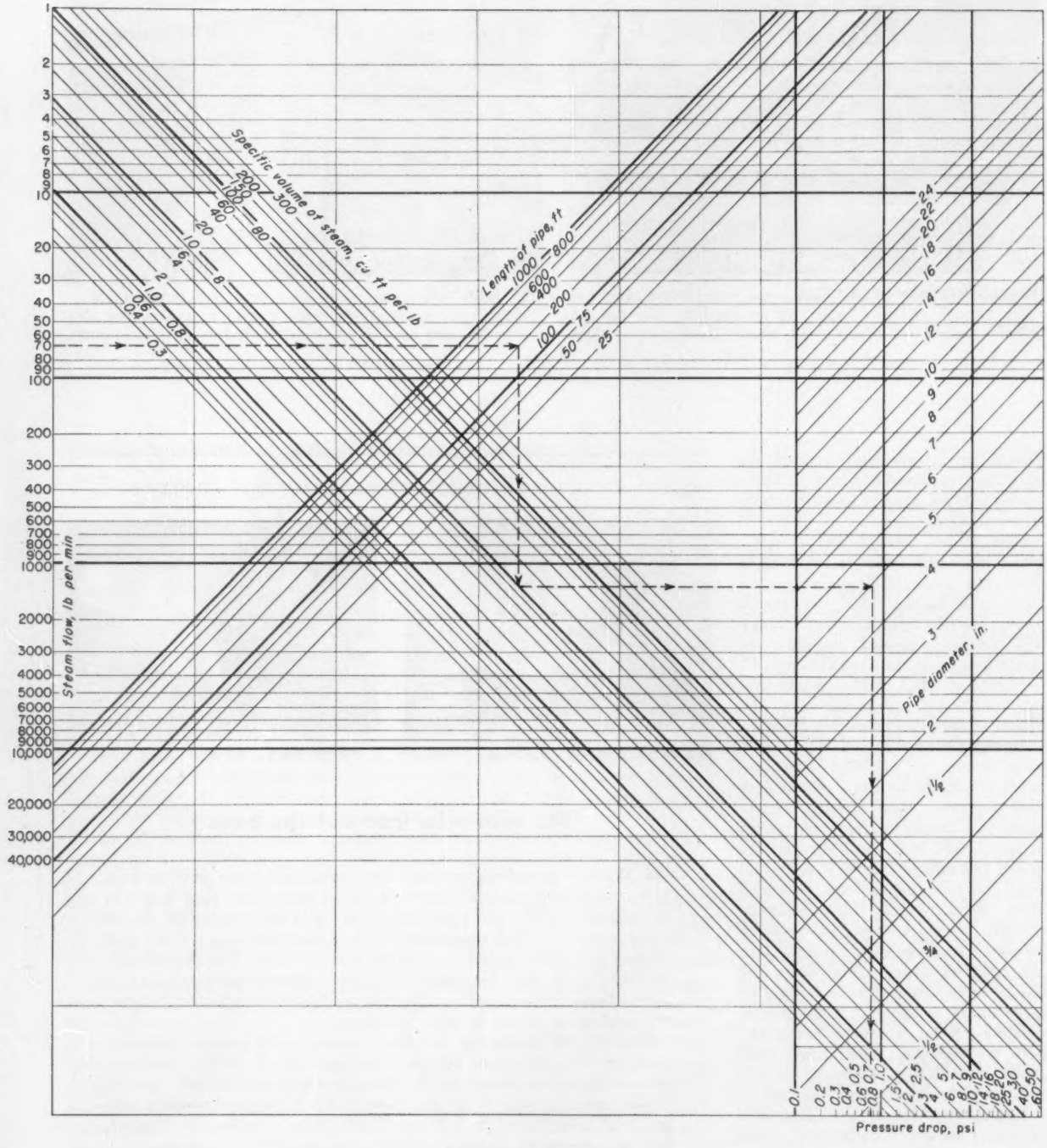
THESE RIGS offer fast plant travel

The men who iron out the bugs

The Mahwah assembly-plant site, comprising 177 acres near Suffern, N. Y., was formerly a golf course and airport before Ford took it over in the summer of 1953. This plant, the largest of Ford's 16 assembly plants, is but part of a major expansion and modernization program that will account for over $2¼ billion since the end of World War II. All told, announced projects in the company's postwar expansion program include 33 new manufacturing and assembly plants, 20 parts depots and 19 major engineering, research and office buildings.

But even with the top planning that is going into all the above projects, problems that crop up during the shakedown period call for smart on-the-job engineering decisions. At Mahwah these problems fall into the capable lap of George C Biggar, plant engineer. Biggar, working with electrical co-ordinator V J Hudon (left photo, standing by Biggar), finds the answer for electrical production snags as they come up.

Getting around a plant this size is a problem in itself. Typical on-the-job travel carts (right) are used by engineering staff.


Specific volume of steam, cu ft per lb
Length of pipe, ft
Steam flow, lb per min
Pipe diameter, in.
Pressure drop, psi

Handy chart sizes steam piping fast

By HENRY F GAUSS, *Assistant Research Engineer, Pack River Lumber Company*

► EVERY TIME a piping system is designed, the problem of selecting the most economical size crops up. This can often be a time-consuming problem, especially when a number of different pipe sizes must be evaluated. The chart on the opposite page is designed to help reduce the time needed to size pipes in various power and industrial applications. Its ranges cover those usually met in modern plants of many different types.

Economics. The smaller the pipe we use for a given steam flow, the lower the first cost of the installation—including pipe, valves and fittings. But as we reduce the size or diameter of the pipe, the pressure loss during flow of steam through the pipes goes up.

Increasing the pipe size reduces the pressure loss during system operation but increases the first cost of pipe, valves and fittings. The problem becomes one of determining the most desirable pipe size, based on the required inlet pressure of unit after steam flow through the pipe, the allowable pressure drop in the line, and the investment which has been approved for the pipe in question. The ultimate aim of any economic analysis is to determine the best size of pipe, taking all pertinent factors into consideration for the installation under study.

Studies. In arriving at the most economical size to use, it is desirable to have a quick and accurate method for determining the effect produced on the pressure drop by varying the diameter for a given length of pipe and flow rate of steam.

The accompanying chart has been developed for studying the relation between pressure drop, pipe size, length, specific volume of the steam, and its flow rate. It is helpful in many types of pipe-sizing problems.

As the basis of this chart, two generally accepted equations are used, as follows:

$$W = [(P_1 - P_2)D^5/174.14(fVL)]^{1/2}$$

and

$$D = [174.14(fVLW^2)/(P_1 - P_2)]^{1/5}$$

where W = steam delivered, lb per min
P_1 = pressure at pipe inlet, psia
P_2 = pressure at pipe outlet, psia
$P_1 - P_2$ = pressure drop in pipe, psi
D = actual inside diameter of pipe, in.
V = specific volume of steam, cu ft per lb
L = length of pipe, ft
f = coefficient of friction
174.14 = a constant

For practical work it is customary to express W in lb per min or lb per hr. When this is done, the numerical constant, coefficient of friction and conversion factors may be absorbed in a single empirical constant given by $C = 87\ [1/(1 + 3.6/D)]^{1/2}$

Chart use. For a single determination of the pipe diameter to deliver a given weight of steam under specified conditions, you can use either of the two expressions above without too much difficulty. But when a number of solutions are necessary to secure comparative values, the work is tedious and a graphical solution becomes highly desirable.

The ranges chosen for the variables in the chart, facing page, make it suitable for all usual industrial steam-flow problems. Pipe diameter varies from ½ to 24 in., specific volume from 0.3 to 300 cu ft per lb, and pipe length from 25 to 1000 ft. Note that it is not necessary to convert the pressure loss obtained from one pipe length to another because the actual length is plotted on the chart. However, where fittings and valves are present, enter the chart with the equivalent length of pipe.

Example: What diameter of pipe should you use for a flow of 67 lb per min of dry saturated steam through a 200-ft-long pipe when the pressure drop allowed is 0.74 psia? The steam flows to a heat exchanger operating at 42.37 psia.

Solution: The average pressure in the pipe will be $42.37 - 0.74/2 = 42$ psia. The corresponding specific volume from the steam tables is 10 cu ft per lb, closely.

Enter the chart on the left at a flow rate of 67 lb per min and project horizontally to a pipe length of 200 ft. From the intersection with the 200-ft-length curve, project vertically to a specific volume of 10 cu ft per lb, as the dashed line shows. From this point draw a horizontal line to the right. Enter the chart at the lower right at 0.74-psia pressure drop and project vertically to intersect the last horizontal line drawn. The two lines intersect at a point giving a diameter of 4.9 in. For the application you would probably choose a standard 5-in. pipe.

When the pressure drop is not known at the start, simply solve from left to right, using different pipe sizes to find the resulting pressure drop. Select best size.

GAS-CONSERVATION PLANT discharges almost 1.5 million scf of gas per day, stands on concrete piling 80 ft above lake bed

Single operator keeps finger on plant pulse through . . .

Centralized control of 60,000-hp gas-turbine plant

- **Few manually operated controls**
- **Load balance maintained automatically**
- **Central or local control as desired**
- **Automatic shutdown of entire plant in emergency**
- **Top efficiency, less manpower mean dollar savings**

By H D GIBSON
Esso Research and Engineering Company
and M D DODD
General Electric Company

► MILES OFFSHORE, Creole Petroleum wells bring up oil and gas from deep below the bottom of Venezuela's Lake Maracaibo. After separation from the oil, the gas is pumped through ten gas-turbine-driven compressors. Then it is discharged at almost 2000 psi back into the oil-and-gas source below.

Injecting gas back into the source eliminates pumping, ups amount of recoverable oil, conserves gas for future use.

Gas turbines are 2-stage 2-shaft units arranged to give seven stages of compression. The high-pressure (first-stage) turbine drives an air compressor (air for fuel-gas mixture) feeding the low-pressure (second-stage) turbine in tandem with the first, but separate from it. The low-pressure turbine drives the multistage process gas compressor.

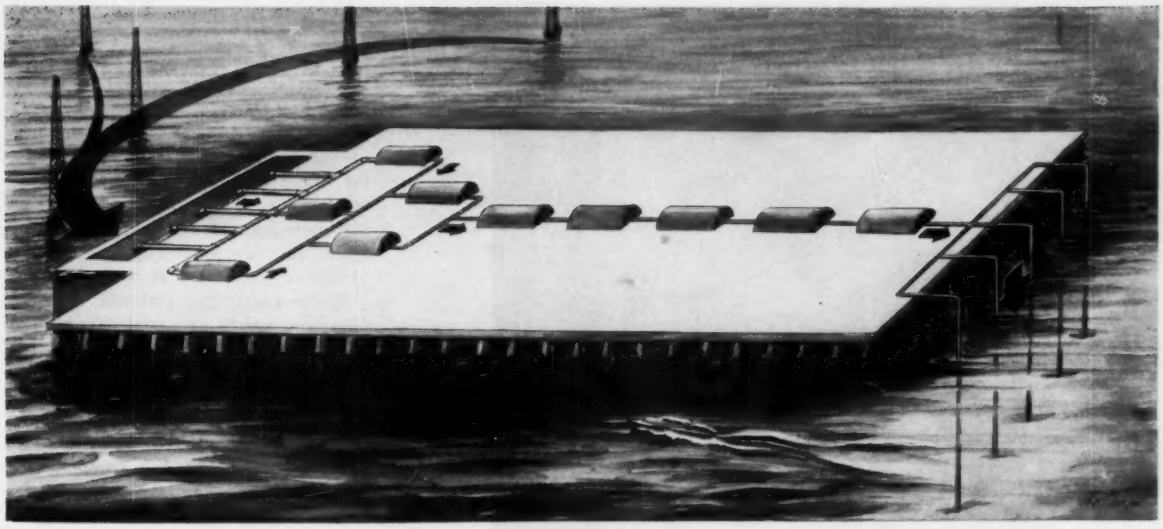
Control board gives to one man the regulation of the world's largest gas-turbine plant. The compact unit has these five sections:

1. Miscellaneous control section has gages, indicators and recorders of station auxiliary performance. Examples: Triple-element draft gage shows differential between pressurized control room and atmosphere. Thermometer shows turbine inlet-header air temperature. Other controls include pushbutton emergency shutdown of auxiliaries.

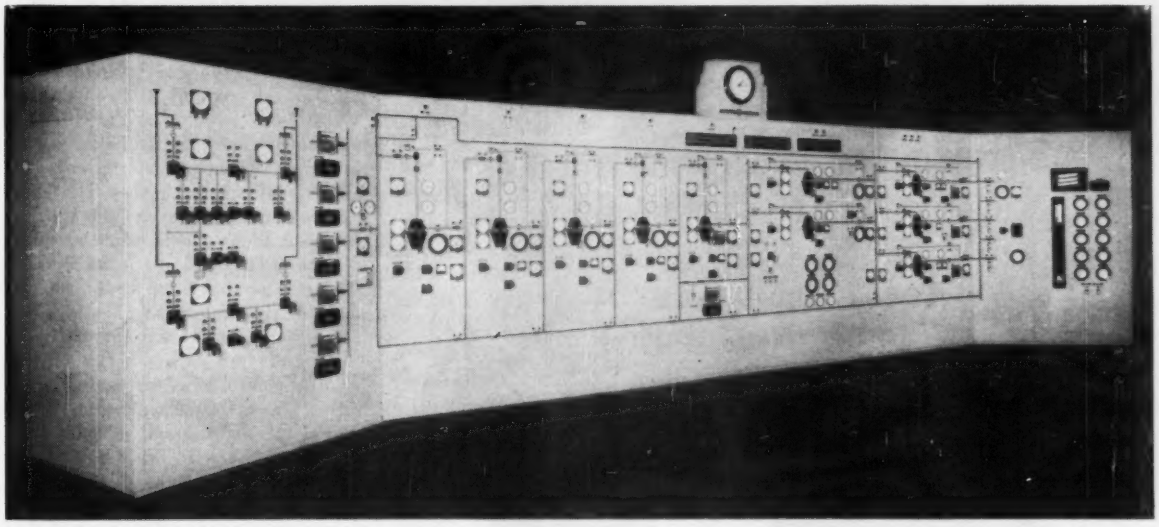
2. Master-regulator segment controls pressures and shows position of each main valve in the five 30-in. station suction lines. Regulator action is automatic or manual.

3. Field and bypass section controls main valves in associated piping. Flow integrators and recorders serve each of five field injector lines. Gages compare field and discharge pressures.

4. Auxiliary power area of board



BASIC ELEMENTS in the gas flow from wells through 7-stage compression. Gas discharges back under lake bed at 1965 psi



CENTRAL-CONTROL BOARD with symbols, mimic buses, flow piping, control lines gives operator control and picture of process

distributes current through two double-ended unit substations, also controls a diesel-driven emergency generator whose start-up is automatic.

5. Turbine-compressor control section is the biggest. Instruments are grouped by stages of compression and machines within stages. Lamps show if a turbine is ready to start, has started, or is stopping. A START or STOP switch relays a signal to the individual turbine-control unit. START impulse causes the turbine to crank, fire and accelerate. Switches actuate motor-operated rheostats in the regular circuits to control speed.

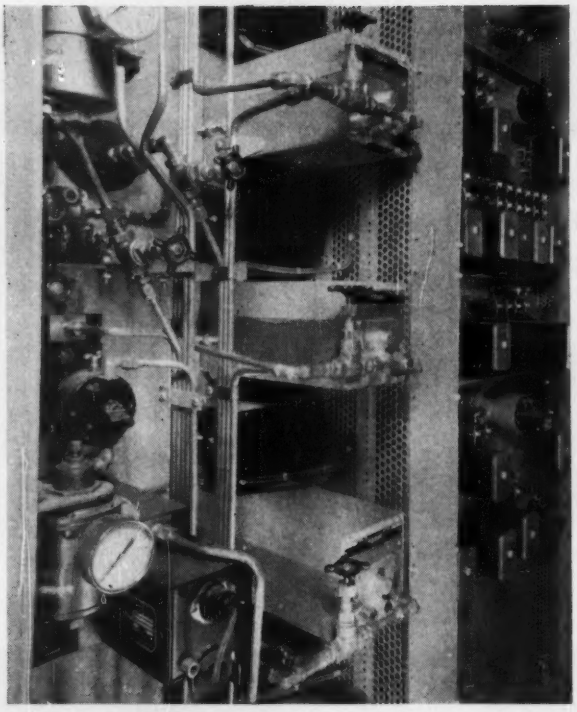
Each turbine has two speed indicators since variable loads cause different speeds of the separate high- and low-pressure turbine shafts. Each compressor suction and discharge pressure shows on a separate gage. Switches give remote control of suction and discharge block valves. Lamps indicate normal or abnormal position of each valve. First- and third-stage compressors show inlet volume on recorders. Other stages have inlet-volume indicators. Flow-indicating gages, an inch larger in diameter than pressure gages, help when quickly scanning the board.

Trouble in the process or auxiliary systems kicks off an annunciator, and a red light warns of trouble in the gas-turbine controls or auxiliaries.

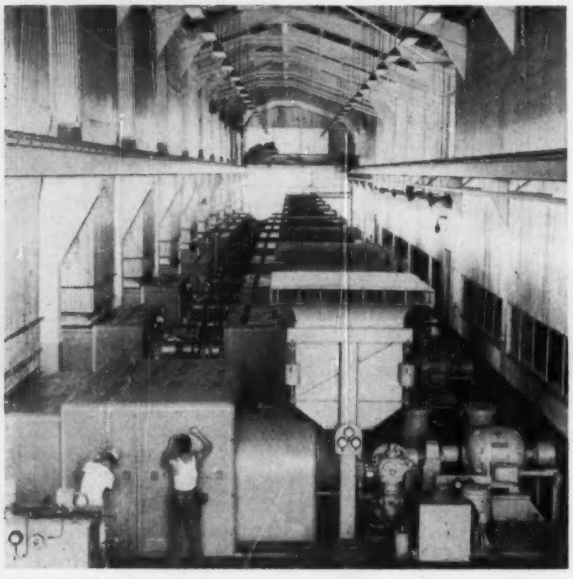
Pneumatic transmitters and receivers, for measuring the critical parameters of the gas-flow system, avoid use of high-pressure lines and, more important, keep flammable gas out of the control room.

Master controls allow holding full field pressure with nine compressors if one must be shut down. Total plant shutdown is automatic under certain emergencies.

Turn page



PNEUMATIC INSTRUMENTS joined by ⅜-in.-OD soft-drawn copper tubing. Perforated troughs support wiring, terminals



TEN 6000-HP 2-shaft 2-stage gas turbines drive multistage compressors, raise process-gas pressure from 25 to 1950 psia

Remote control, plus picture of performance, is feature of control board. However, local stations also give automatic or manual control of main units and auxiliaries. After plant shutdown, turbine and station auxiliaries, such as the seal oil pumps and the instrument air compressors, are all started by local control.

While a man normally doing routine plant work does the starting, the central-board operator supervises. His gages, instruments and alarms keep him informed.

Performance of the ten turbine compressors, the equalized flow through the three first-stage and two second-stage compressors, and auxiliary functions, all tell their story to the board operator. Ends of the board are turned out 30 degrees so from the center he can see each instrument. Control is automatic, but can be switched to manual at the remote board if desired.

Major units, like turbines, heat exchangers, valves and controllers, show up on the board in their characteristic mimic symbols. Mimic buses connect gas-flow lines, control lines, and electrical-power circuits. Devices are arranged functionally and, so far as possible, controls and instruments for a piece of apparatus are next to its mimic symbol.

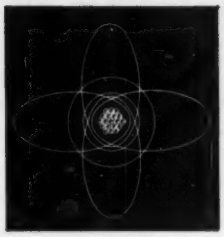
Board design detail includes 14 standard duplex units, each having two rows of panels joined by top sections to form a tunnel. Ends of the tunnel have access doors that can be locked. This safety feature also prevents tampering. Bottom of board is left open for cables, wires and tubing. Bolted together, the assembly is self-supporting.

Three-way switches at the ends control interior lighting. An outlet at each end gives ac power for testing or operating small power tools. The front panels contain all devices the operator must see. Rear panels mount auxiliary devices, control and interlocking relays. Devices not suitable for flush mounting, such as motor-operated rheostats, air-pressure regulators, are spotted inside the board.

Valve controllers, for main-gas-line valves, gages, instruments and recorders, are pneumatic, can be isolated for inspection or repair. Each supply line has an air filter and pressure regulator. The layout of connections and tubing permits routing to center of panel, then a fall-away from the connected instrument.

Wiring, formed into horizontal bundles, runs to a perforated trough on either side of panel, comes out at terminal blocks. External wiring, from remote stations, comes to the trough, and from there to the opposite side of the terminal block. The trough thus supports terminal blocks, internal and external wiring. This arrangement of wiring and tubing simplifies field connections, gives a neat appearance, and a well-balanced board.

Maintenance costs are expected to be low. One-man operation will cut labor costs. Standard construction of duplex units saved design time and cost. Such well-balanced centralized-control boards can be used for similar applications.



Nuclear notes

By B G A SKROTZKI, *Associate Editor*

Twenty years imprisonment and a $20,000 fine await the violator of AEC security regulations if he acts to injure the U.S. or give advantage to a foreign nation. Industrial security officers for firms working in the atomic field must make sure their company security procedures follow published AEC rules. In general, private firms will develop their own methods of guarding atomic information and materials—but they must conform to minimum AEC prescribed requirements.

About 107,000 people work in the atomic field, both weapons and power phases. Of these, only about 6000 work directly for AEC, the rest work for private industries, who function as AEC contractors. The plants, laboratories and other installations are in 22 states and house some of the costliest machines ever built. These facilities stand on reservations covering about 3200 square miles, an area roughly equal to Delaware and Rhode Island combined.

Sodium-cooled graphite-moderated nuclear-power-plant proposal to develop 75 mw has been resubmitted to AEC by Consumers Public Power District of Nebraska. North American Aviation, Inc will carry out development and design phases of the plant. AEC will pay a fixed amount toward the cost of the reactor plant and will retain title to those parts so financed. Consumers will run the entire plant, to start operation in 1959.

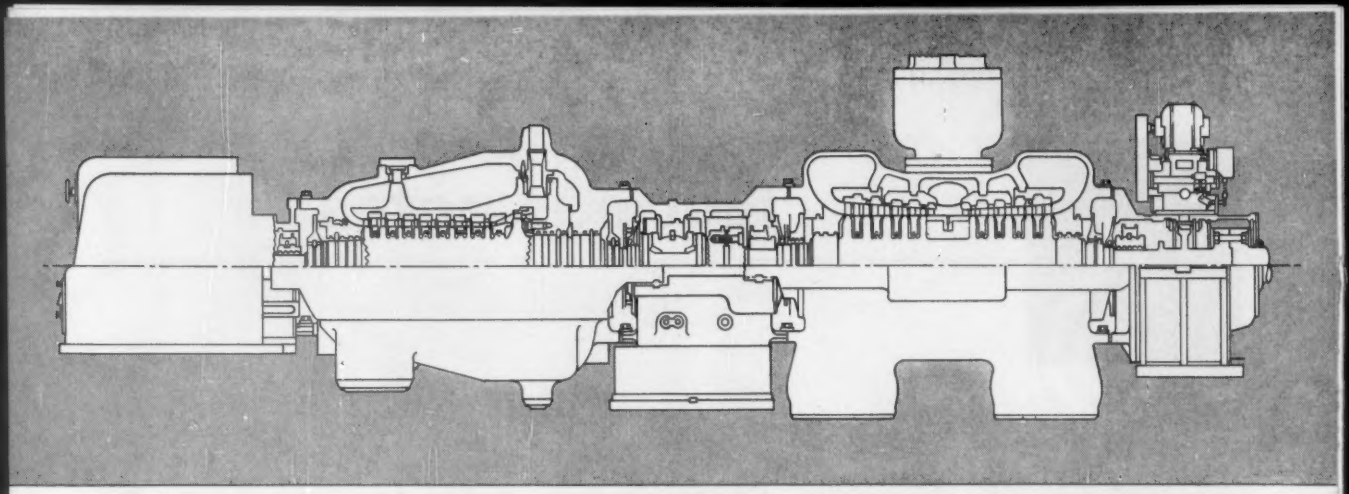
Fast-neutron breeder reactor components will be built full size for testing, says Atomic Power Development Associates, Inc. Testing will be done at Detroit Edison's Delray Station, without nuclear fuels. Components may be used in actual reactor plant after testing. Test facility will cost about $4,300,000 and start running early in 1957. Association includes 32 utilities, 9 manufacturing, engineering and research firms who support a staff of 76 scientists, engineers and technicians. Much of the development work is done by companies and contractors.

Reactor components for APDA now being procured include: reactor vessel containing sodium coolant and nuclear core; rotating shield plug assembly covering vessel and penetrated by control-drive mechanisms and fuel-handling devices; offset handling mechanism mounted upon and extending through shield plug to insert and remove hot fuel elements, breeder elements and control rods; 11,800-gpm sump-type liquid-sodium pump driven by 1000-hp motor. About $7,500,000 has already been spent on the fast-neutron breeder reactor program.

An all-nuclear Navy seems to be in prospect, according to Rear Adm H G Rickover, who predicts that by early 1960s all new major vessels planned will be nuclear propelled. He says the AEC is developing a series of reactors ranging from about 3000- to 40,000-shaft hp; these can be used singly or in multiple. Five new types of reactor plants are now being designed for specific ship drive.

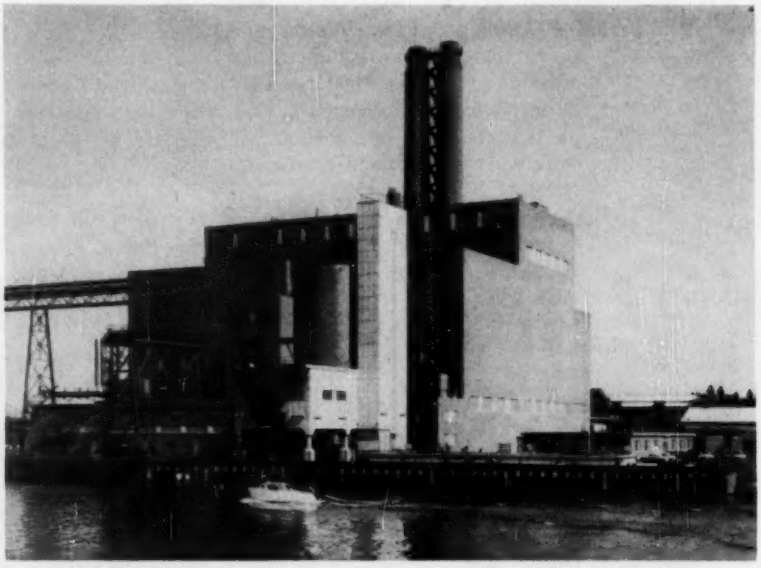
Lease charges for nuclear fuels will be waived for five years starting the day of issuance of an AEC operating license. This provision replaces the original waiver of seven years starting on date of submitting proposals. This applies to nuclear power plants participating in the reactor demonstration program.

Biggest headache of all still to be cured in the power reactor field is the development of reactor fuel elements that have long life and can stand the gaff.



HIGH-PRESSURE ELEMENT of 335,000-kw 2-in. backpressure nameplate-rating cross-compound 3600-rpm reheat turbine. It has a single-flow 9-stage high-pressure turbine, a 5-stage intermediate reheat turbine arranged for double flow

Largest metropolitan utility will expand its generating capacity with a record-size unit. This giant will have several new features in design and operation; outstanding departure is that . . .



ASTORIA STATION of Consolidated Edison Co of New York now has two units with total capacity of 360,000 kw. Plant takes cooling water from East River in city

Astoria's No. 3 main turbine drives

► ASTORIA STATION's Unit No. 3 highlights the latest features of the art of central design. In addition to being the largest unit ever projected, its high-pressure turbine will drive the main feedwater pump as well as one of the two main generators.

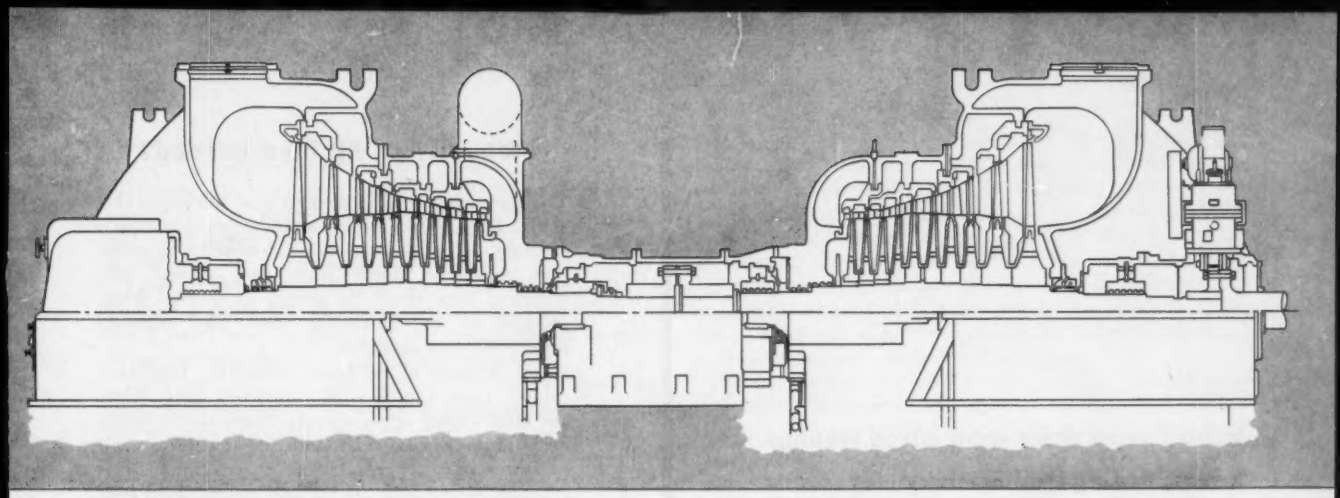
The single-boiler single-turbine unit will use the reheat-regenerative cycle, and will supply process steam to a gas-making plant.

Steam generator for No. 3 will have a pressurized furnace to produce a h-p flow of 2,400,000 lb per hr at 2150 psig and 1050 F at the superheater outlet. Reheater outlet temperature will be 1000 F and pressure about 520 psig. Babcock & Wilcox Co will build the unit.

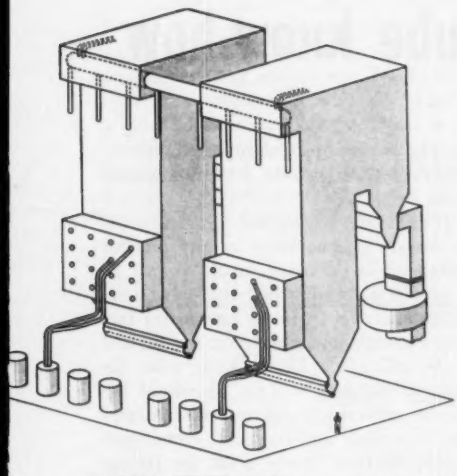
The twin-furnace arrangement places superheater surface at outlet of one furnace and the reheater surface at outlet of the other. This gives considerable flexibility in running the unit at varying loads and constant temperature.

Each of eight pulverizers will supply coal to four burners—making a total of 32 burners for the twin furnaces. Pressurized combustion gas flows through the completely watercooled furnaces, over the convection surfaces, through the regenerative air heaters to the dust collectors and up the stack. No induced-draft fans will be used.

This natural-circulation unit uses one drum to separate steam and water. The



LOW-PRESSURE ELEMENT of cross-compound reheat turbine has 10-stage double-flow arrangement. Each end of turbine exhausts into separate surface condensers connected by a steam duct to balance the turbine-exhaust steam pressures



STEAM GENERATOR to produce record flow has twin-furnace setup, one drum

feed pump

drum will weigh over 200 tons. The unit will be the largest central-station steam generator, and one of the most efficient.

Turbine-generator No. 3, a cross-compound unit running at 3600/1800 rpm will be designed for 2000 psig, 1050/1000 F, 2-in. Hg abs. The turbine is rated about 300,000 kw, running at rated initial pressure and with uncontrolled extraction steam at three pressure levels for process needs in the Astoria gas plant. When operating at maximum guaranteed throttle flow, 1-in.-Hg abs backpressure, and extracting steam for feedwater heating only, the turbine will develop 344,100 kw. General Electric Co is building the unit.

The 5-stage double-flow reheat section of the turbine will allow using a compact crossover arrangement. This saves space and reduces the amount of steam in the crossover, minimizing the overspeed hazard when the turbine dumps its full load.

The h-p element will be a separate cylinder with nine stages. High throttle flow leads to using an external valve chest mounted in front of the unit. Both the h-p and the double-flow intermediate elements will be of double-shell construction. There will be two intercept valves on the upper half shell beneath the turbine lagging.

The 1800-rpm double-flow l-p unit will have ten stages. The last-stage buckets will be 43 in. long, giving a total annulus area of 248 sq ft. A separate condenser mounts below each end of the turbine. An equalizer pipe balances the exhaust pressure.

Total rating of the generators will be 427,500 kva, 0.8 pf at 30-psig hydrogen pressure. They will be hydrogen-gas conductor cooled. Generating voltage will be in the range of 18 to 22 kv. A motor-generator exciter will serve the main generators.

Main condenser will consist of two 50% shells joined by a steam duct. The C H Wheeler single-pass unit will condense 1,600,000 lb per hr steam at 1.86 in. Hg abs with 244,000 gpm circulating water at 73 F. Total surface of 187,000 sq ft consists of 27,450 aluminum-brass tubes 30 ft long. Expansion joints connect condensers to turbine exhaust nozzles.

Two circulators, each 122,000 gpm at 17.4 ft tdh and 178 rpm, will be driven by 700-hp motors. Pumps will be vertical, mixed flow, submerged pull-out type.

Boiler-feed pumps arrangement makes this unit unique. The h-p turbine element will drive a Byron-Jackson 5-stage pump through an American Blower Corp 12,000-hp fluid-drive coupling. The pump will deliver 6330 gpm against 6400 ft tdh when turning at 3510 rpm, and with feedwater at 363 F. The pump will be driven by the generator shaft.

For starting and standby there will be two Byron-Jackson 9-stage feed pumps capable of delivering 3165 gpm against 6650 ft, tdh. Each will be driven by a separate 6000-hp motor.

Fans for the steam generator will be of the forced-draft type only. Four American Blower Corp air-foil-type fans will each deliver 250,000 cu ft at 42-in. static pressure. Each fan will be driven by a 2000-hp 1180-rpm motor.

Heat balance hookup of the unit uses seven heaters. Two h-p heaters running at about 580 and 250 psia will have integral drain coolers. These will cascade their drains back to the deaerating heater running at about 144 psia. The four l-p heaters cascade their drains through a drain cooler back to the condenser.

When passing the guaranteed maximum throttle flow of 2,222,000 lb per hr and heating feedwater only, the reheater passes 1,997,300 lb per hr, the h-p generator produces 169,200 kw and the l-p generator 174,900 kw.

The record-size unit is expected to start running in the year 1958.

In past years there were mixed feelings toward using radioactivity for wear studies. But excellent results to date are fast changing the picture. Here's a timely report on how . . .

When is an EP lube needed?

There are six factors in modern gear lubricants that assure long life of the transmission unit: *viscosity, viscosity index, pour point, rust prevention, oxidation resistance, foam suppression.* Lube oils, equipped with these six properties to the extent required by the particular drive, give excellent service in most gear units.

But in many of the heavy industries, like steel, rubber, cement and paper, enclosed gear drives are often called on to operate under severe shock loads or overloads. Therefore, the resulting tooth pressures are extremely high.

Under such conditions the best conventional mineral oil available, even with all its superior qualities, may not be adequate to provide the desired factor of safety for such gear drives. So to meet this need, gear oils are available compounded with materials to give EP properties.

Radioactive tracers speed EP lube know-how

► ELEMENTS like sulfur, chlorine and phosphorus have the unique property of arresting metal scoring, thereby increasing an oil's load-carrying capacity. This is not new. Since the early 1920s a number of extreme-pressure (EP) agents have been developed. Their role over the years, as additives to lubricating and cutting oil, has been quite significant.

Behavior of EP films was discussed by V N Borsoff and C D Wagner of Shell Development Company at ASLE-ASME joint meeting in Indianapolis, Ind. October 1955. Authors' work concerned gears lubricated with a mineral oil compounded with dibenzyl disulfide containing radioactive sulfur. Formation and behavior of resultant film on load-bearing surfaces was scrutinized, using beta particles from sulfur as the means of detecting the film, measuring its thickness.

After describing mechanics of the experiments, results boiled down to the simple fact that *EP film thickness increases with load, is not affected by length of running.* This in itself suggests an appropriate steady-state thickness of EP film is established for each operating condition. Also, minimum thickness of EP film occurs at the pitch circle, gradually increasing toward the addendum and dedendum. These observations point up the belief that temperature under actual gear contact controls formation of an EP film. Maximum film thickness noted by Borsoff and Wagner was 0.2×10^{-8} in. This thickness is less than the average height of asperities of a surface finished to 20 micro-inches.

What is EP? A clear verbal picture of the mechanism of EP lubrication was painted by W Davey in a lecture on the aspects of friction and lubrication at the London Polytechnic some time back. Davey pointed out that when two metal surfaces are in contact, wear and a high coefficient of friction can be sidestepped only by providing a lube layer *that is more readily sheared than the metallic junctions between surfaces* (POWER, December 1951, p 83).

Boundary lubrication is concerned with surface phenomena, particularly with absorption effects. EP lubrication is best regarded as the most severe case of boundary lubrication. Of the three theories put forward to explain boundary lubrication, the mechanical theory, based on bulk properties has been largely discarded. Davey proposed combining the physical adsorption and chemical theories into a comprehensive theory of EP lubrication.

Here's the point. Hydrocarbons are not generally adsorbed at metal or at metal-oxide surfaces to any marked extent. If a polar compound is dissolved in oil, it can be shown by changes in interfacial tension that the polar compound tends to concentrate at the surface. Interfacial tension is a minimum when a complete monolayer at the surface is in equilibrium with the bulk of the blend. More polar the compound, more strongly adsorbed it will be. Dipole of the molecule is adsorbed at the surface and the degree of adsorption depends on nature of surface and the polar compound. For mechanical strength, surface layers must be tightly packed, or more than one molecule thick. Value of the adsorbed film as a lubricant depends on mobility of adsorbed molecules' free end.

Lubricants spread away from surface hot spots. And even with the best lubricants some wear occurs, clearly indicating discontinuity of lubricant layer. Remember, behavior of pure compounds on surfaces is quite different from that of the same compounds in oil because of differences in degree of adsorption. No control of the extent of adsorption is possible when using oil blends while polar and hydrocarbon molecules compete for the surface.

Physically or chemically adsorbed films affect boundary lubrication under relatively mild conditions. But as conditions become more severe, hot spots develop and complete breakdown of the film occurs. If the adsorbed film can react chemically with surface under severe conditions to form a new film, this new film may then serve to protect surfaces against seizure and wear. To achieve this result, the new film must shear readily by plastic flow or melt at a lower temperature than the intermediate junctions. It's this sort of mechanism that explains function of acids as boundary lubricants, also the way EP additives work.

Davey points out further that although nearly every element in the periodic table has been proposed as possessing EP activity, there are actually four main groups of com-

pounds, alone or in suitable combinations, that are in general use: (1) organo-metal compounds, particularly lead soaps (2) reactive sulfur and selenium compounds (3) halogen compounds (4) phosphorous compounds. Where combinations of these additives are used they, quite naturally, must be compatible and the mixed blend stable.

Radioactive-tracer technique was used by Borsoff and Wagner to study EP film formation and behavior. But before digging into the details of this technique, let us go a bit further with the theory of EP film formation.

With steel rubbing surfaces, all EP agents based on sulfur form iron-sulfide films. Those based on chlorine form iron chloride, phosphorus reacts to form iron phosphide or iron phosphate films. Existence of such films has been verified with chemical analysis, X-ray and electron diffraction patterns. But the mechanism of forming EP films right on the rubbing surface of machine elements, and their thickness and action in preventing scoring are little known and understood. Right now, with development of the radioactive tracer technique and availability of radioactive isotopes, great possibilities are offered for expanding knowledge on mechanism of formation and action of EP films.

Lab tests by Borsoff and Wagner were run on a spur gear machine. Gears were 17- and 19-tooth involute spur gears of 6 diametrical pitch, 20-deg pressure angle, 0.25 in. face width. Made from the equivalent of SAE 3312 steel, gears operated at 3000 rpm with a lube flow rate of 10 ml per second and load increments of 5 lb on the scale. This latter value corresponds to a contact load of 360 psi. Running time at each load setting was 30 min, 1 hr, 3 hr.

After the run at each load, gears were removed by special instruments and washed with a hydrocarbon solvent. Such washing removed about 2% of the film formed. Dried gears were then examined for radioactivity.

Roundup data on using radioactive tracers in studying wear can be found in a paper presented at ASLE annual meeting, Chicago April 1955 by Hundere, Lawrason and O'Meara. These authors point out that radioactive technique for evaluating wear was patented in 1941 by Ferris of Atlantic Refining Company. Ferris was unsuccessful, however, in making the technique practical because, at that time, the only source of artifically radioactive tracers was the cyclotron. As a result he had to introduce his tracer, phosphorus, at the beginning of manufacturing process.

Hundere pointed out further that in 1947, Primo Pinotti of California Research Corp, without knowing of Atlantic's patent, conceived the idea of utilizing a nuclear reactor to obtain radioactive parts via nuclear bombardment. This greatly simplified the procedure, giving a higher activity. It also meant the technique was now practical for wear studies.

Much of the recent work reported by Hundere et al concerns piston ring and engine wear. They did some work, however, with radioactive tracer technique in studying gear wear, using a Ryder 4-square power-circulating machine equipped with test spur gears. Test-oil system was of the continuous monitoring type and wear was recorded continuously on a strip chart.

Standard procedure for determining load-carrying ability of gears is to load them till a fixed amount of wear or scuffing occurs. Load at that point is defined as the lube rating. But since it is impractical to obtain perfect gears, one always has the gear variations affecting lube ratings. It is more desirable to compare load-carrying ability of unknown oil with a reference oil on the same rubbing surfaces. Several ways of accomplishing this with gears have been tried. It is not a simple matter with involute gears as with piston rings because of change in gear tooth profile that accompanies wear. Therefore, load-carrying ability increases with wear.

Meet Bob Bellas, *Power's* new assistant editor

► WE SPENT many months ferreting out likely candidates for the recent opening on POWER's editorial staff (July 1955, p 5). Final screening found R C Bellas from Chillicothe, Ohio, best fitted to move into POWER's editorial family. And this he did.

Bob Bellas steps into the editorial field with a solid background of technical schooling and years of practical field experience. Training includes graduation from Pennsylvania Nautical School (marine engineering) and attendance at Drexel Institute of Technology and University of Miami.

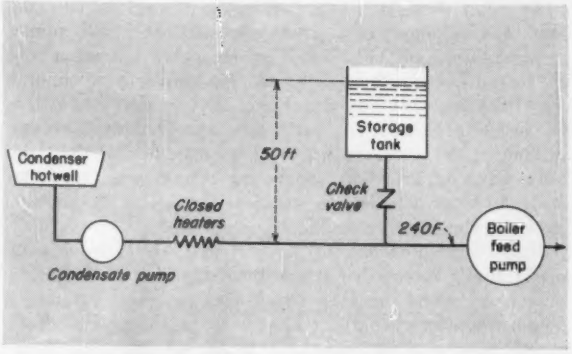
Bob's years as a marine engineer included service aboard the first American ship to enter the Soviet Union after diplomatic relations with this country were resumed. He helped build ships at the Philadelphia Navy Yard, served as power-plant engineer at the Naval Air Station in Miami.

First as field inspector, later as resident shop inspector, with Hartford Steam Boiler group, Bob spent many years in even closer proximity with everyday operating power equipment. On associating with Maryland Casualty Co in 1950, Bellas assisted in design and shop-testing of first *ASME Code* pressure vessel of special chrome-nickel alloy for a chemical-plant catalytic reactor. Next forward step came in October 1954 when he joined Development Engrg Div of Goodyear Atomic Corp, operators of gaseous diffusion plant near Portsmouth, Ohio.

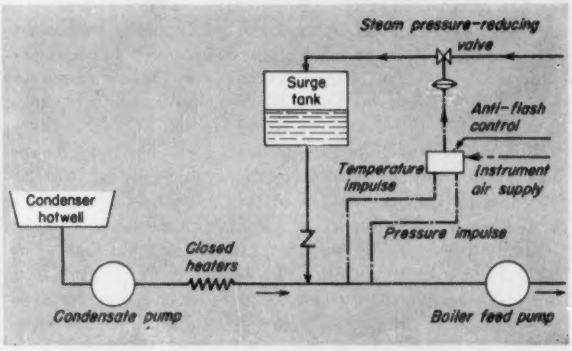
Besides being a member of National Board of Boiler and Pressure Vessel Inspectors, Bob is active in the American Welding Society, having served as Vice-Chairman of Maryland Section. The Little League and Boy Scouts take up any slack in his schedule . . . time he is not with his wife and three children.

In the months to come watch for evidence of Bob's promising ability as he assumes a full-scale editorial mantle.

Robert C Bellas



1 Arrangement of surge tank in a typical closed feedwater cycle. This hookup was common in older central stations



2 Application of antiflash control mechanism to the surge tank used as a protective device in newer closed cycles

How load changes affect closed feed cycles

Piping arrangement, controls and safety devices are important in successful operation of closed cycles and standby feed pumps under transient conditions

By **IGOR KARASSIK**, *Manager, Multistage Pump Section, Worthington Corp,*
G H BOSWORTH, *Senior Engineer, Bechtel Corp, and*
WARREN ELSTON, *Assistant Engineer, Pacific Gas and Electric Co*

► PROBLEMS met in closed feed cycles under transient conditions—where a condensate or booster pump maintains feed-pump suction pressure—are entirely different from those in an open cycle. (For Parts 1 and 2 of this series, see Oct, p 96 and Nov, p 87). Pressure developed by the condensate or booster pump increases with reduction in flow (load on turbine). Friction loss between condensate and feed pumps also becomes less.

Sudden load increase, likewise, should cause no hydraulic problems if the pumps preceding the feed pump are selected as already discussed in this series. Also, you must consider the relative effects of acceleration in the feed- and condensate-pump discharge, and operation beyond rating.

With two half-capacity feed pumps, the effects of sudden load increase have to be analyzed when but one pump operates. Head-capacity curve of the single pump under these conditions will intersect the system-head curve at a flow greater than the pump design capacity. So it is necessary to ascertain that the condensate or booster-pump discharge pressure exceeds the prevailing vapor pressure at all times, insuring sufficient npsh at the feed pump.

Condensate-pump failure poses no urgent problems in the open cycle because the direct-contact heater has sufficient storage capacity to allow the feed pump to run 5 to 15 minutes, or more, depending on load. This is long enough to either start the condensate pump or shut down the boiler.

Closed cycles have no such safety measure and complete failure of the feed supply at the feed-pump suction cannot be tolerated. Some protective means to prevent this must be provided.

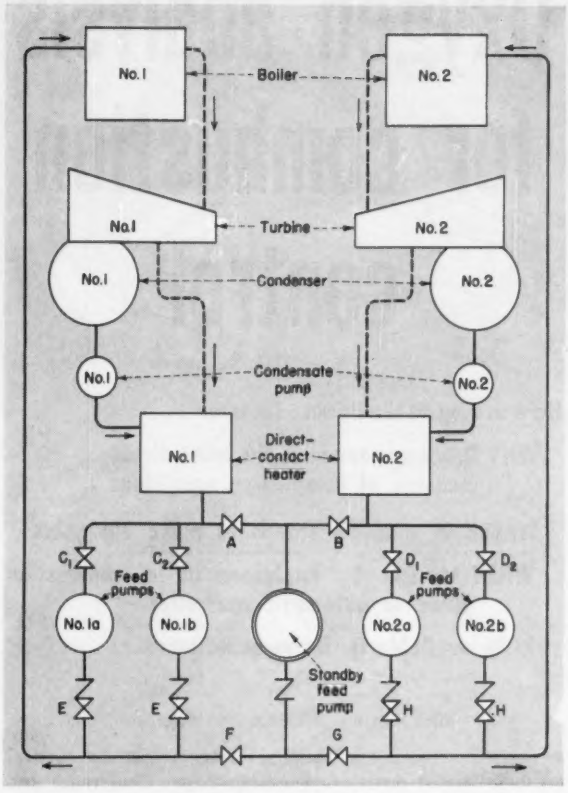
Early closed cycles had an elevated surge or a storage tank connected to the feed-pump suction, Fig. 1. When condensate supply failed, the cold water flowed from the tank to the feed pump suction as soon as the static head exceeded the suction-line pressure.

Modern stations using larger capacity feed pumps cannot use the hookup in Fig. 1 because the minimum npsh required is considerably higher and the feedwater temperature is also much higher.

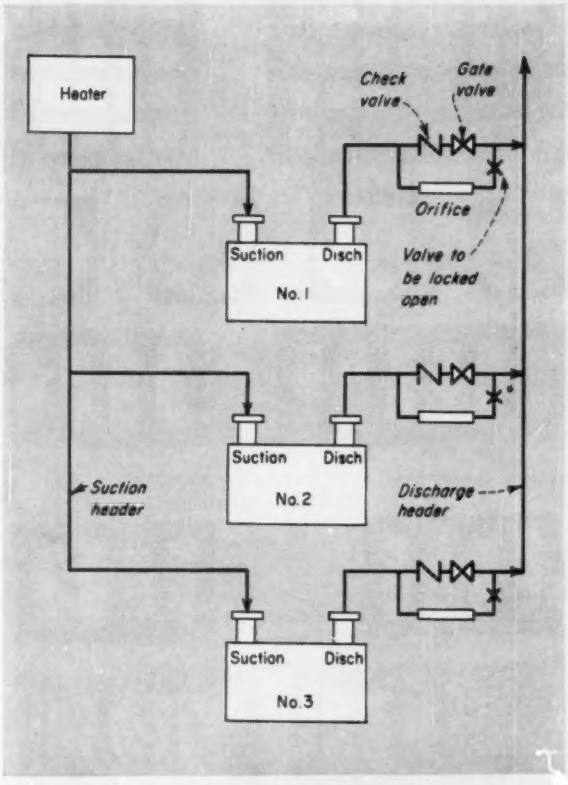
This problem has two solutions: (1) Failure of suction pressure in feed line, resulting from condensate-pump trouble, causes feed pumps to stop, allowing the boiler protective controls to handle this unit's problems. To assure maximum protection, the condensate pump is chosen to provide some excess pressure over the minimum permissible feed-pump suction pressure recommended.

When suction pressure falls below the normal value, a pressure switch starts a standby condensate pump. If this fails to solve the problem, a second pressure switch cuts off the feed-pump power supply. Second pressure switch should have a time-delay relay, giving a lag of about 5 sec to allow for start-up of the standby condensate pump. Exact lag depends on feed pump used and the effect of flashing on it. Switch should also have automatic reset.

(2) Cold-water surge tank on suction side of feed pumps, Fig. 2, is located at a convenient level and supercharged with either steam or some inert gas like nitrogen. Pressure-reducing valve in steam line can be controlled by a pressure switch like that used to start the standby condensate pump in



3 Piping arrangement for a 2-unit power plant fitted with a common spare boiler-feed pump for the two steam boilers



4 Typical warm-up recirculation piping hookup for standby boiler feed pump. Correct piping arrangement is important

method (1), or the antiflash-mechanism impulse, Fig. 2, can be used. The mechanism measures available npsh.

COMMON PROBLEMS

Cold starting of feed pumps affects various designs differently. Each must be studied carefully to determine if starting without warm-up is safe. Use of a single standby pump for two adjacent boilers, now a common hookup, introduces some operating problems. Fig. 3 shows a typical piping hookup for this type of plant.

Since time is short during an emergency, the installation must be arranged so the standby can be started when any pump on normal service fails to develop sufficient pressure. Standby pump may take its suction from either of two deaerating heaters; suction lines to pump must be valved to prevent flow from one heater to the other. These valves have to be kept closed, unless the standby pump is to be kept warm at all times. Then one valve is opened; the other is kept closed. Likewise, both discharge valves must be kept closed, or one open and one closed. Means have to be provided to quickly switch the standby pump from one feed system to the other during emergency because the system with the open valves may not be the one in which failure occurs in the pump, valves, piping, etc.

In Fig. 3, valves *A*, *B*, *F* and *G* may be normally closed. When the standby pump operates with unit No. 1, valves *A* and *F* are opened; for operation with unit No. 2, valves *B* and *G* are open. Alternately, *A* and *F* may be left permanently open. They are closed only when the pump is needed for unit No. 2, instead of No. 1. With this arrangement, the standby pump is connected to the correct feed system for some of the emergencies that may arise. This is a statistical improvement over having the pump shut off to both units.

Valves *A*, *B*, *F* and *G* are normally motorized and arranged to operate automatically on reduction in the discharge pressure in either feed-pump header. Pressure switch to operate the valves starts the pump but the pump starting circuit has a suitable time-delay mechanism. This prevents the pump starting until the proper valves have been open or closed.

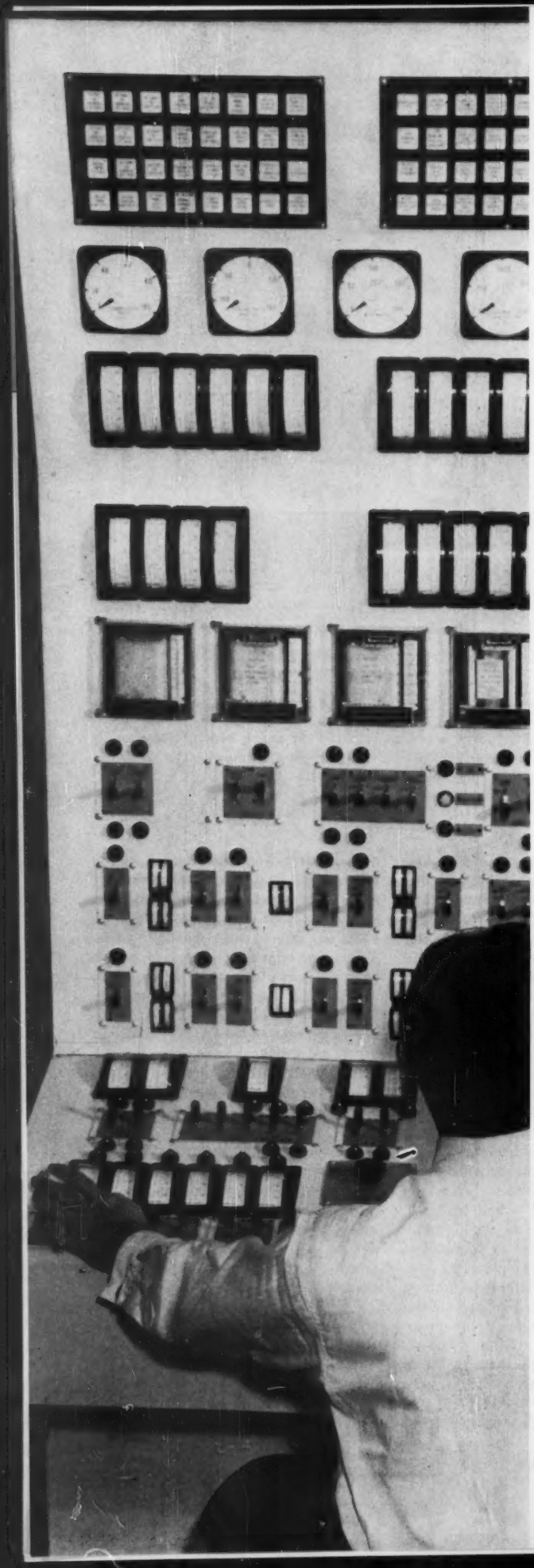
Standby hookup. To prevent leakage of water from the standby pump, which might lead to seizure on start-up, one suction valve should be kept open at all times. Or a small bypass can be installed around one suction valve. Another arrangement is to lead a pipe from the pump to a point in the cycle which is always at a lower pressure. A small orifice must be used in this line to prevent an excessive pressure in the vessel during pump operation.

Time delay during start-up of the standby is less important where two half-capacity pumps are used for feed service. This means use of a standby pump for two adjacent units is more justifiable with two half-capacity pumps than a single full-capacity pump.

Since the standby pump may take its suction from either heater, its recirculation bypass lines must be arranged to return bypass flow to either heater. Even if pump starts with the recirculating line open to the wrong heater, no serious damage occurs.

Balancing device. Under no circumstances should a pump fitted with a balancing device be operated while its leakoff line is closed. With a leakoff

(*Continued on page 202*)



Oxygen analysis for combustion control

Here are up-to-the-minute facts on . . .

WHY O_2 measurement is the most direct measure of combustion conditions

WHERE O_2 analysis stands to make big gains

WHEN to use O_2 analyzers as a combustion guide or automatic controller

HOW available O_2 instruments work

► SITTING IN on recent technical society meetings—Instrument Society of America, American Power Conference and ASME gatherings—POWER editors have listened with keen interest to an increasing number of papers, lively discussions focusing on continuous oxygen analysis. Our initial reaction: Why the rash of stepped-up activity in oxygen analyzers—after engineers have lived for years with the orsat analyzer and CO_2 recorder?

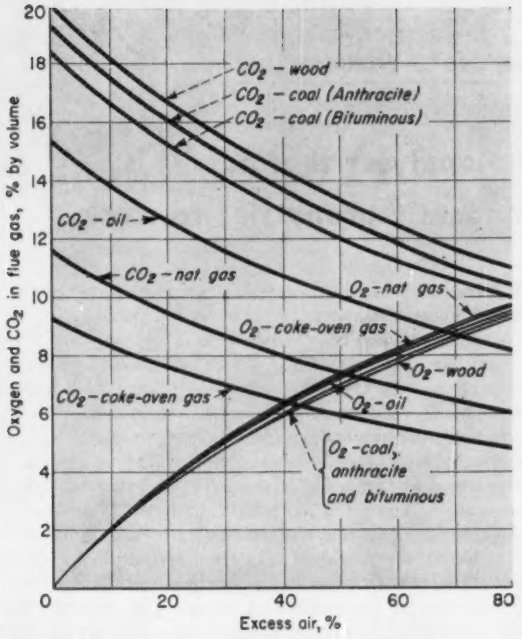
Before we tackle the central problem—oxygen analysis itself—let's step back for a moment, orient ourselves on the general problems of combustion control for today's complex steam generators. In doing so we'll come up with the answer to our lead-off question, above.

Basic problem in any combustion control, for boilers or process heaters, is getting the right proportion of fuel and air. To do the job we need an accurate way of measuring these items—either directly, or by measuring another quantity that's related to fuel or air flow.

For boiler furnaces, steam flow is closely related to fuel flow. We've used it for many years as an indirect measure of fuel in conventional steam-flow air-flow control systems—mainly for solid-fuels firing.

Steam-flow air-flow meters assume that a fixed quantity of air is needed to produce a pound of steam. If steam at 600 psig, 600 F, containing 1287 Btu per lb is generated from feedwater at about 300 F, 268 Btu per lb, the difference —1019 Btu per lb—must be supplied by the boiler. Since this heat must come from the fuel, relation between heat absorbed in the boiler and heat released by the fuel affects the combustion-control system. If boiler efficiency is 75%, 1358 Btu is supplied by fuel for each pound of steam. For a typical bituminous coal, 7.7 lb of air produces 10,000 Btu. Adding 40% excess air to the theoretical value, we need 1.46 lb air for each lb steam. Steam-flow air-flow meter is calibrated so pens are together when 1.46 lb of air is flowing for each pound of steam.

Although steam-flow air-flow relation is based on several


Oxygen and CO_2 in flue gas, % by volume
Excess air, %
CO_2 – wood
CO_2 – coal (Anthracite)
CO_2 – coal (Bituminous)
CO_2 – oil
CO_2 – nat gas
O_2 – nat gas
O_2 – coke-oven gas
O_2 – wood
CO_2 – coke-oven gas
O_2 – oil
O_2 – coal, anthracite and bituminous

EXCESS AIR varies little with O_2 content of flue gas as we vary the fuel. But CO_2 content shows a big excess-air spread

By **HOWARD KALLEN**, *Assistant Editor*

assumptions, it's accurate enough to act as a reliable guide in many of today's plants.

Limitations of steam-flow air-flow: Any factor affecting boiler efficiency or heat transfer within the boiler (slagging, too-high flue-gas velocity, etc) introduces error. Steam-temperature, pressure, feedwater-flow variations also present problems. Air temperature must be fairly constant. And fuel type, quality changes can seriously affect relation between Btu release and air requirements.

Steam flow can usually be measured close enough for most common control jobs. But steam-flow measurement is only half the problem. We still need to measure air flow accurately. Enough draft loss is often available across the boiler itself to provide an air-flow index. Sometimes designers use an orifice or venturi section in the duct between f-d fan and furnace to measure air flow.

But many of the latest complex furnaces make accurate air-flow measurement tough. And today's trend to even bigger and more advanced furnace designs holds little hope of improving the situation. Controlled-superheat, controlled-reheat boiler furnaces, gas-distribution dampers, bypass dampers have made air-flow gaging across boiler's sections almost impossible. Big problem on some boilers: Low draft loss makes it difficult to get accurate readings.

Fuel-flow air-flow meters can do a good job where fuels are fired in suspension—oil, gas, pulverized coal. But if fuel is subject to heating-value variations we run into problems similar to those associated with steam-flow air-flow control: Air required for combustion changes with fuel's heating value, specific gravity.

CO_2 and O_2 analyzers. For furnaces firing single fuels—where hydrogen-carbon ratio changes only slightly—the continuous CO_2 analyzer is a dependable combustion guide because relation between CO_2 in flue gas and combustion air is fixed by the fuel's hydrogen-carbon (H/C) ratio. We needn't assume that a constant number of Btu's are

(*Continued at bottom of p 92*)

In brief . . . why oxygen analysis

Main object in burning any fuel: To use all available combustible without losing valuable Btu's up the stack or in the ashpit. We must supply enough oxygen to burn all fuel. But excess oxygen and nitrogen (air) must be heated—heat that's lost to the atmosphere. So air supply must be held to a practical minimum.

Fuel-flow air-flow . . .

For fuels burned in suspension it's usually possible to accurately measure fuel flow and proportion air supply to it—if Btu's per pound of fuel stay constant. But if heating value, specific gravity vary, fuel-flow air-flow, as a combustion guide, can introduce substantial error.

Steam-flow air-flow . . .

For solid-fuels firing, steam flow is commonly used as an indirect measure of fuel flow. While pounds of air per pound of fuel vary widely with coal's heating value, moisture and ash content, Btu release, (as measured by steam flow) per pound of air used, is almost constant—regardless of coal's heating value.

But measuring steam-flow air-flow isn't always OK because: (1) Feedwater temperature variations affect Btu's absorbed per pound of steam. (2) Excess air needed for efficient combustion varies with fuel-burning rate. (3) Overfiring, underfiring can introduce error in steam-flow air-flow.

Measuring air flow in small and medium-sized furnaces is relatively simple. But accurate air-flow measurement in large, complex boiler furnaces is difficult. And where flows must be totalized in several ducts, accurate measurement is virtually impossible.

CO_2 measurement . . .

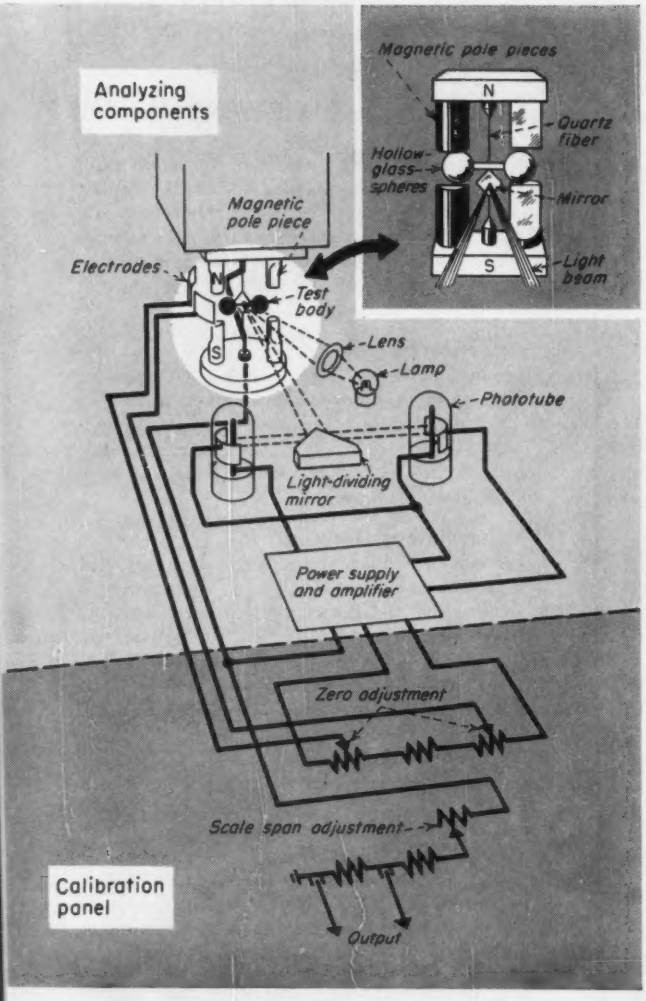
For any single fuel with a relatively constant hydrogen-carbon ratio, CO_2 content of combustion gas is a direct check on combustion efficiency. It isn't affected by feedwater, air, fuel variations. But it means little where fuel's hydrogen-carbon ratio changes. And where several fuels are burned in the same furnace, CO_2 measurement won't do the job.

O_2 measurement . . .

While CO_2 content of flue gas varies for different fuels, O_2 remains relatively constant. So, for example, 6% O_2 in flue gas indicates roughly 40% excess air, regardless of fuel burned, graph at top.

Net results . . .

Continuous oxygen analysis is finding wide use where small or large installations burn varying-quality fuels. On bigger jobs oxygen analyzers supplement steam-flow air-flow or fuel-flow air-flow controls — even when fuel quality is relatively constant. Reason: It acts as a valuable check on validity of fuel and air-flow measurements, permits operator to compensate combustion controls, improve boiler efficiency. And, on newest installations, O_2 analyzers are being used as automatic controllers.



MAGNETIC O_2 ANALYZER, null-balance type, measures electrostatic force needed to balance magnetic force due to O_2

ARNOLD O BECKMAN, INC

An analyzer that puts O_2's magnetic properties to work

Oxygen, being highly magnetic, is unique among gases. Although most common gases are only slightly affected by magnetism, oxygen is so sensitive to it that only a few parts per million can be spotted in a magnetic field. In physicists' language: Oxygen is *paramagnetic*—it has a high *magnetic susceptibility*. Beckman analyzers put this principle to work.

In their null-balance-type analyzer an oxygen testing unit is restored to its null or neutral position by an electrostatic force equal and opposite to magnetic force produced by the gas sample. To do the job a light dumbbell is supported on a quartz fiber between magnetic polepieces, drawing at left. Each ball of the dumbbell is in a nonuniform magnetic field. And the dumbbell itself has a fixed magnetic susceptibility. When a sample gas containing oxygen surrounds the dumbbell suspension, resulting magnetic force depends on the difference between magnetic properties of suspension and gas. Force tends to rotate the dumbbell about quartz fiber. And effect is proportional to oxygen content of gas.

To operate recorder the dumbbell suspension is coated with rhodium, making it conductive. A pair of electrodes near one ball is at a fixed voltage. So the ball is in an electrical field. When presence of oxygen yields a magnetic force that tries to rotate dumbbell, it's opposed by force due to the electrical field. Result: Voltage required to hold the dumbbell suspension in neutral position is a measure of oxygen concentration.

To supply and measure this voltage, a beam of light reflects on a mirror attached to the dumbbells. This beam, drawing at left, divides between two photoelectric cells. Cells' outputs are in balance when suspension is in its null position. When suspension rotates, light on cells is unequal. Resulting unbalanced output voltage from cells is amplified, used to rebalance dumbbells. The voltage is also measured and recorded on a standard potentiometer.

---

absorbed by a pound of steam. Reason: CO_2 analysis is a direct check on a combustion product.

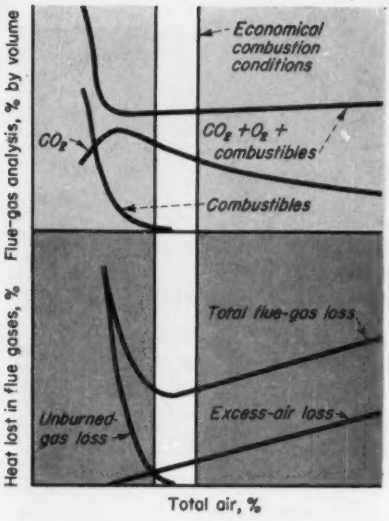
But a close look at combustion chemistry shows that CO_2, in flue gas, varies substantially when fuel's H/C ratio changes. Carbon is at one end of the H/C ratio scale—zero H/C. Coke and hard coals come close to this limit. At opposite end of the range, methane, main component of natural gas, has a 0.33 H/C. Graph, p 91, shows, for instance, that with 40% excess air, CO_2 for natural gas is about 8.5%. For bituminous coal, it's almost 13%.

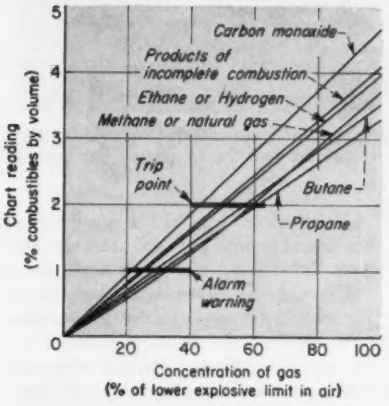
The graph also shows that while CO_2 varies widely for different fuels, O_2 content of the flue gas stays within a relatively narrow band. At 40% excess air, spread between natural gas and bituminous coal is less than 0.2%. Another look at combustion chemistry tells why. O_2 analysis, like CO_2, checks combustion gases directly (steam-flow air-flow and fuel-flow air-flow are indirect methods). By measuring O_2 in flue gas we're, in effect, gaging excess air itself.

Why didn't automatic O_2 control take hold until recently —especially since basic combustion facts have pointed to its desirability for years? We put this query to leading instrument engineers. Their response: Answers to tough design problems have come along only recently. An accurate, reliable O_2 analyzer, suitable for automatic control, must (1) have high response speed (2) be capable of handling dirty, high-temperature gases (3) be able to operate continuously with minimum maintenance (4) check a true gas sample.

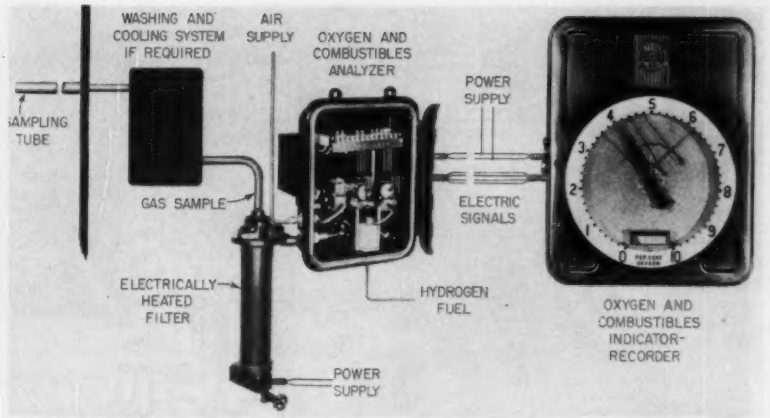
Early analyzers were complex instruments, needed high-quality maintenance—lots of it. And gas sampling techniques lacked refinements needed to insure a true gas sample. Despite high response speeds needed by analyzers for today's complex boiler plant, the gas sample must often be taken from a hot, dirty location. So the gas sample must be cooled, cleaned and supplied to the analyzer—all in about 15 seconds or less. Anything slower introduces time lags, makes control unreliable.

Latest design analyzers meet these rigid specs. They're continuously sampling high-temperature gases. And high-dust-loading problems in pulverized-coal, stoker-fired furnaces have been virtually eliminated.

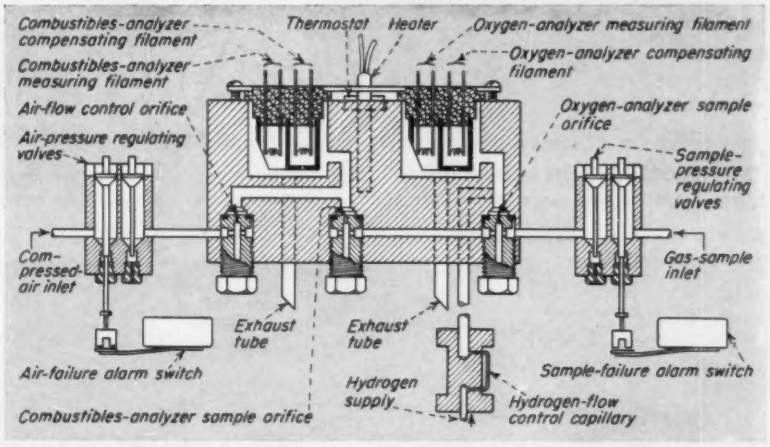




BEST COMBUSTION ZONE shown at top. Bottom, effect of combustibles in gas



OXYGEN-COMBUSTIBLES INSTRUMENTS help keep excess air to a practical minimum, show up incomplete combustion by spotting combustibles in the flue gas



HYDROGEN COMBINES WITH OXYGEN and burns in the presence of a heated noble-metal catalyst. Heating effect is proportional to oxygen present in the gas

BAILEY METER COMPANY

An O_2-combustibles analyzer that operates by catalytic combustion

To help boost combustion efficiency, protect against unsafe combustion conditions, Bailey analyzers keep a close vigil on combustibles as well as oxygen in flue gas. They're dual-purpose instruments.

Graph, top at left, shows why they've combined two units. It shows typical losses in flue gas, depending on fuel-air ratio. There's an optimum zone slightly on the excess-air side that yields maximum economy. The oxygen analyzer is used to control in this area. The combustibles analyzer warns operator that unburned combustibles are going up the stack. Since unburned losses can be high, the instrument is a valuable combustion guide. It also warns operator to trip fuel or trips it automatically if combustibles' concentration nears explosive limit, graph, lower left.

Designing a gas-sampling system for continuous sampling of dirty or slag-carrying flue gas, with freedom from plugging, was a major Bailey aim. Here's thinking that helped them succeed: Flue gas contains water vapor. And where sample temperature is reduced to the dewpoint, (usually a short distance from where sample tube comes through furnace wall) water causes dirt to get sticky, clog sampling tube. So they've installed an inductor that introduces water tangentially, where gas sample passes out of furnace wall. Mixture of water and gas is pulled into a gas pump (a single-storage centrifugal). Separator and drier on pump discharge removes dirt, water, thus insuring a clean, dry gas sample.

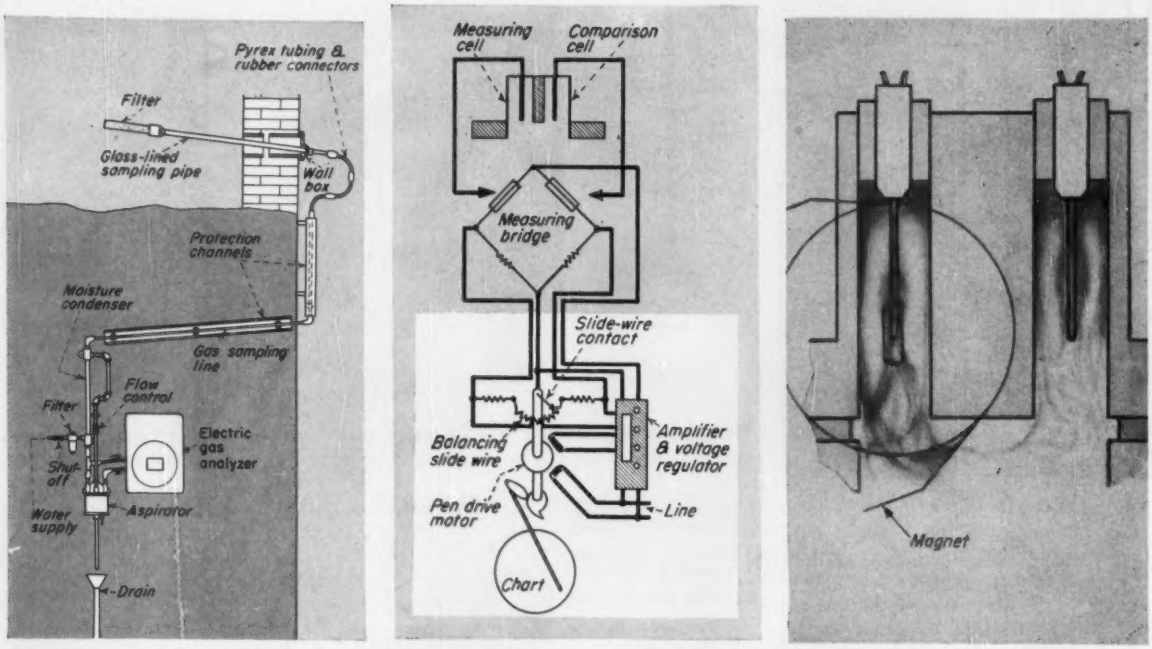
Swinging over now to the analyzer diagram, lower right, the catalytic combustion method utilizes a continuous gas sample mixed with hydrogen, in the presence of a heated noble-metal catalytic filament. The mixture burns. And resulting temperature rise, increased electrical resistance of the measuring filament are proportional to oxygen present in the gas. Heated filament is one leg of an ac bridge circuit. Compensating filament, also shown in drawing above, balances out effect of small variations in bridge voltage, chamber temperature, heat, conductivity of gas.

In combustibles section, air is added to the sample before it enters cell. Filament's temperature rise is proportional to sample's combustibles content.

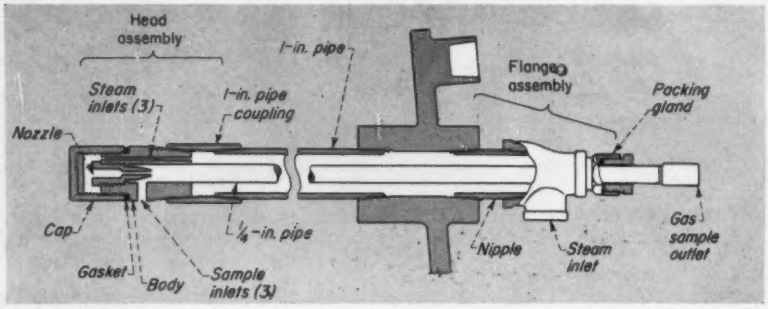
Recording unit for both oxygen and combustibles operates electronically.

Bailey engineers recognized possibility of a corrosion problem from sample point all the way through to the analyzer. And they've selected materials for the system with this in mind.

Turn page for other designs



MAJOR COMPONENTS of Hays analyzer. *Left*, the entire system, from sampling point to analyzer. *Center*, analyzing and recording section. *Right*, details of measuring, comparison cells. Magnet over measuring cell attracts the oxygen in gas sample



STEAM GASPIRATOR TYPE sampling system is designed for difficult sampling problems. Steam condenses around dirt and flyash, cleaning combustion-gas sample

THE HAYS CORPORATION

Their newest sampling system is designed for high-dust loading, high temperature

Directing their efforts toward applications that have proved troublesome in the past—high-dust load conditions often found in pulverized coal, cyclone burners — Hays engineers have developed a sampling system that uses steam, drawing above. They call it the *Gaspirator*. Here's how it operates:

Steam enters outer tube of the Gaspirator (sampling tube) that projects into path of the flue gas. Here it picks up some superheat. It then passes through the nozzle and into the inner tube where steam mixes with flue gas, dust that's sucked in. After mixture flows through tube it goes to the condenser. Steam condenses around each flyash particle, washing it down through a moisture separator. Result is a clean gas sample, ready for the analyzer.

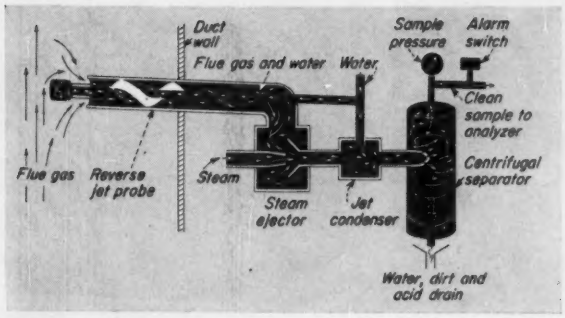
Advantages. Only part of the sample under suction is that within the Gaspirator head itself. As soon as sample mixes with steam, combination is under positive pressure. So leaks in the sample line can't introduce error. The unit, in effect, acts like a positive-displacement pump. Furnace pressure jogs have little or no effect on sample flow.

Drawings at top show how the analyzer itself operates. Entire gas sample flows through the passage block. Part of sample diffuses upward through lower section of the measuring and comparison cells, top at right.

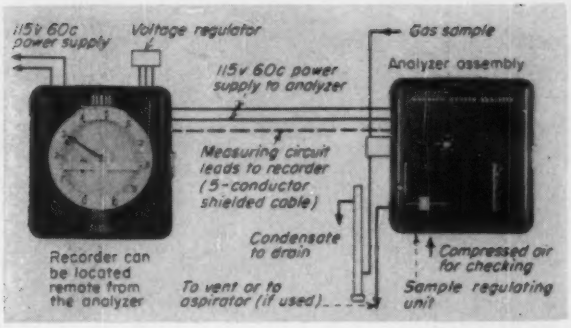
During regular operation, the magnet is swung in position shown, creating a strong magnetic field in the measuring cell only. Oxygen-bearing gas is attracted to the magnetic field surrounding the heated resistor. Result: Gas cools resistor and oxygen in gas loses its magnetism rapidly (in proportion to square of its temperature rise). Heated demagnetized gas is forced out of the magnetic field and upward along the resistor by cooler, more magnetic oxygen-bearing gas from below. Cooling of resistor by gas, and flow rate into magnetic field are directly related to magnetic strength (O_2 content) of gas.

Cooling of both measuring and comparison resistors reduces their electrical resistance. Change in comparison cell's resistance is subtracted from change in measuring cell. Net resistance is, therefore, due only to magnetic effect of oxygen content. And to make sure pressure changes near cells don't cut down analyzer accuracy, the Hays unit has automatic pressure compensation.

The measuring bridge circuit feeds into the recording section, diagram above, where unbalance is electronically amplified, indicated and recorded.



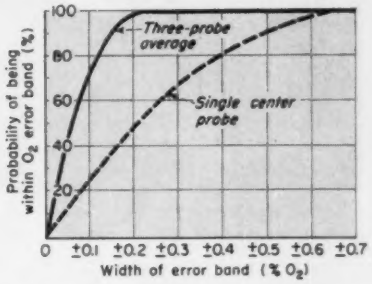
REVERSE JET PROBE sampling system uses water jet to flush sampling probe continuously. Clean gas leaves the separator


115v 60c power supply
Voltage regulator
Gas sample
Analyzer assembly
115v 60c power supply to analyzer
Measuring circuit leads to recorder (5-conductor shielded cable)
Condensate to drain
Compressed air for checking
Recorder can be located remote from the analyzer
To vent or to aspirator (if used)
Sample regulating unit

SYSTEM HOOKUP of the analyzing-recording section. Automatic control can be added by utilizing a recorder-controller

LEEDS & NORTHRUP COMPANY

Multiple probes insure true gas sample . . . analyzer is thermomagnetic



PROBABILITY CURVE shows advantage of three probes for accurate gas sampling

Main components of L&N's O_2 analyzing system are: (1) reverse jet probe and steam sampler, top at left. (2) magnetic O_2 analyzer. (3) electronic recorder or recorder-controller—where unit is used for automatic control. System hookup is shown at top, right.

Most critical part of any analyzer is its sampling system. When operators get unreliable sampling they lose confidence in O_2 analysis. L&N's new sampling scheme is designed to lick this problem.

Tracing out drawing, top at left, sampler is a stainless-steel probe with reverse jet nozzle spraying high-speed water jets through the probe. Water keeps it flushed continuously. And no water gets into the gas duct. Steam ejector pulls flue gas and flushing water from probe, discharges mixture into centrifugal separator through a jet of condensing water. Washed sample leaves top of separator under pressure. Dirt, flyash and water drain from bottom.

Copper sampling line can't plug or corrode because: (1) It's under positive pressure. (2) Gas sample is cleaned before it enters sampling line. And sample speed is so high (45 fps) that the analyzer can be as much as 200 feet away from sampling point without excessive time lag.

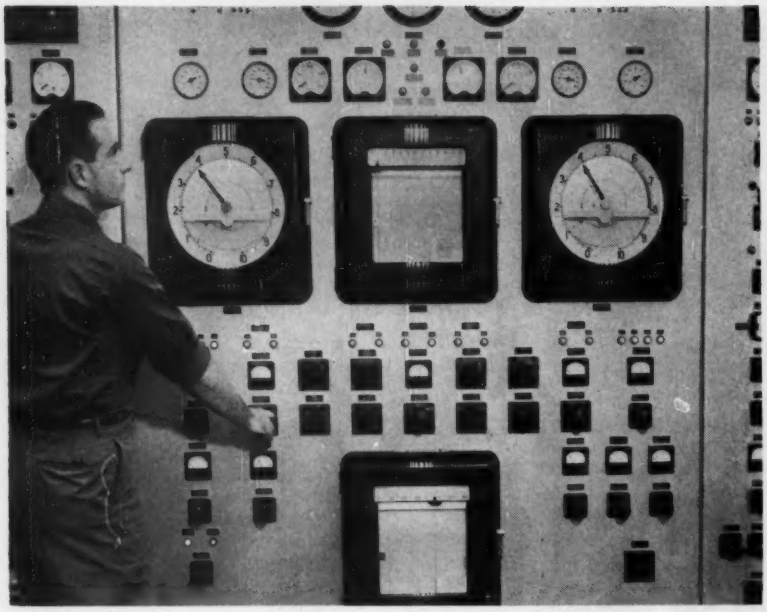
Getting a true sample. L&N uses multiple probes to insure a true oxygen sample. Here's why: In modern boilers having big ducts, flue gas can stratify. Gas mixture varies from layer to layer. And dampers in gas passes continually change the flow pattern. Test traverses taken by L&N engineers on big boilers show that oxygen readings can be 1.5% O_2 apart—in the same duct and at the same time. This corresponds to about 10% excess air. Curves, above at right, apply probability laws to several hundred traverse readings taken at different loads on a modern boiler. Three-probe average is within ± 0.2% of an average sample more than 95% of the time.

Basically, the analyzer puts thermomagnetic principles to work—much like the unit we talked about, opposite page. Comparison and test cells both receive part of gas sample. Magnetic field in test cell attracts oxygen. So gas cooling of electrical resistor in cell is due to both thermal and magnetic convection. Cooling in comparison cell is due to thermal convection only. Difference between the two represents cooling effect of oxygen only. Measuring bridge circuit reads resulting electrical resistance dip.

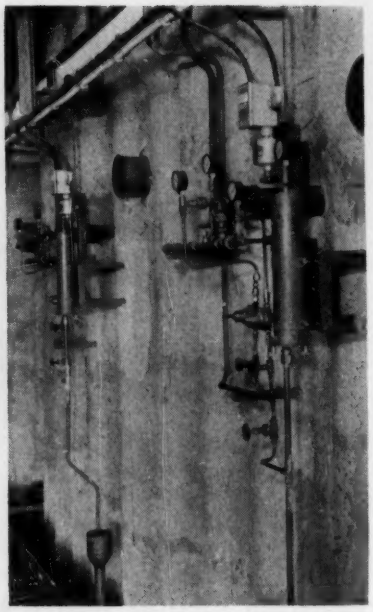
Barometric or static pressure changes would affect accuracy of magnetic analyzing principle. L&N eliminates this error with a second bridge circuit, operating on air instead of gas. Pressure changes have equal effect on both bridges. They're cancelled out in the circuitry, insuring accuracy of results.

OPERATOR CHECKS O_2 recorder readings

For actual installations, turn page



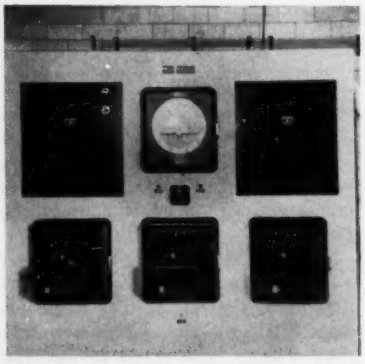
MASTER PANEL at Philadelphia Electric's Cromby station. Operator is biasing the control to carry higher excess air in the superheat furnace of their new boiler



SAMPLING PROBES at economizer outlet feed sample averaging units 150 ft away

AT PHILADELPHIA ELECTRIC'S CROMBY STATION

O_2 analyzers automatically control excess air in superheat-reheat furnaces



AUXILIARY PANEL includes two averaging units, three analyzers and recorder

Philadelphia Electric's new 200,000-kw unit at Cromby Station went into operation last August. It's a twin furnace, tangentially fired boiler operating at 1800 psig, 1000 F, both for superheat and reheat. PE engineers control excess air relation between the superheat and reheat furnaces automatically with two oxygen-recording controllers, above at left.

These L&N units hold equal or preset excess-air bias. Operator, top at left, is biasing the control to carry higher excess air in the superheat furnace to help equalize steam temperatures. Once set, the oxygen control automatically maintains the bias.

The two analyzers receive their average gas sample from two averaging units on the panel. Units combine samples from six reverse jet probes (three for each furnace). Samples are combined on a metered flow basis to get a true average for the analyzers.

Recorder and analyzer at center of auxiliary panel, bottom at right, are used for test. This setup allows test engineers to traverse either the superheat or reheat duct—one probe at a time—without disturbing control-system operation. Traverse checks show up difficult-to-find inefficient conditions—poor burner adjustments, unbalanced fuel feeding.

Test recorder is also equipped to check on the superheat or reheat analyzer and recorder. It transmits signals to an indicator in the control room and can be switched to same sample as either the superheat or reheat analyzer. So the operator has an independent check on either controller. Also, the test system can be cut into the automatic control from control room if either regular system is out of service.

Photo at top, right, shows reverse jet probes and steam samplers. They're at the economizer outlet, feed sample averaging units about 150 feet away. High-speed sampling permits control-room operators to detect, within 13 seconds, a change in flue-gas oxygen at the probes. Rapid response to such changes is essential to automatic control.

Results to date: Oxygen control has been on automatic since a week after start up. Its reliability has won confidence of operators, test engineers. Initial headaches with filtered river water (used in jet sprays) have been licked. And the equipment has needed relatively little attention.

Value of average sampling has also been confirmed by orsat traverses of the ducts. Recorded oxygen has generally been within 0.2% O_2 of average of the orsat readings.

The Cromby installation is a big step forward in acceptance of oxygen analysis, alongside today's more conventional methods, for boiler combustion control.

AT COLUMBIA-SOUTHERN CHEMICAL CORPORATION

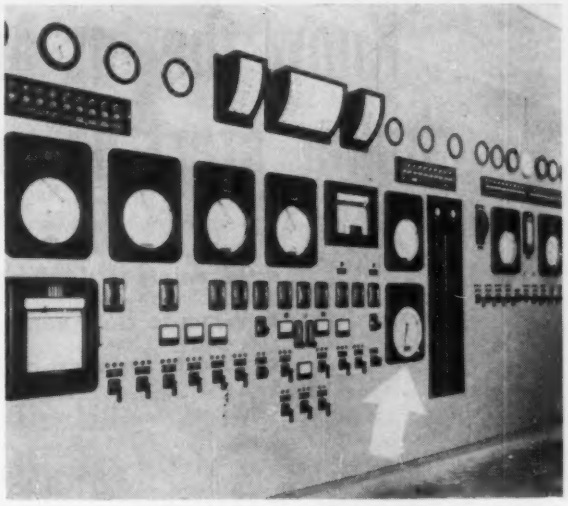
O_2 recorders act as continuous check on cyclone-fired boiler

Columbia-Southern's power plant in Barberton, Ohio, checks the ratio of coal to air in its twin-cyclone-fired boiler with a Bailey oxygen analyzer-recorder, arrow on photo, right. Operators manually readjust coal-air ratio from these records.

C-S continuously samples flue gas in the furnace—at the throat of each cyclone. This setup calls for watercooled, water-washed stainless-steel sampling tubes to withstand high furnace temperature—about 3000 F.

To combat deterioration of sampling tubes due to acid formation on the outer jacket, warm cooling water is used. Engineers designed system to take 140-F cooling water from condensate return. It passes through sample tubes and returns to the hotwell at about 155 F. Warm water does a good job of trimming down acid condensate formation on sampling tube's outer jacket.

Although sampling tubes are water washed to keep flyash, dirt from clogging tubes and analyzer, C-S blows them down once a week with compressed air. Blowdown gives them added protection, insures trouble-free operation. Sampling tubes point up smart design under high-temp conditions. They stay in continuous service well over year at a time.



BOILER CONTROL PANEL, 350,000-lb-per-hr twin-cyclone-fired unit. Two-pen O_2 recorder (arrow) is combustion guide

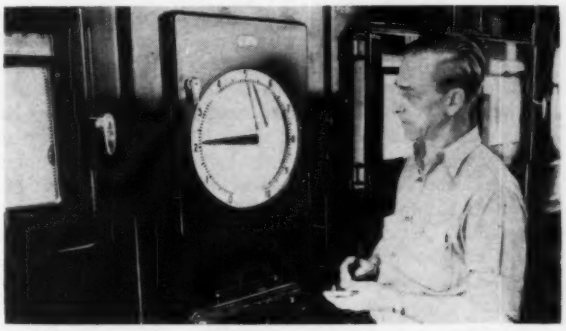
AT SOCONY-MOBIL OIL COMPANY

O_2 recorder helps trim fuel cost 20%

Process heaters are basically similar to boilers: Heat input is equal to heat output plus losses. At the Trenton, Michigan refinery of Socony-Mobil, engineers estimated that they could save 20% on their yearly fuel bill by slashing these losses, getting top combustion efficiency.

Big feature of the dollar-saving program was installation of the Hays Magno-Therm oxygen recorder, right. Unit, a direct measure of excess air, keeps air to a minimum, still permits heater to get complete combustion.

S-M engineers ruled out CO_2 analysis because of varying H/C ratio of fuels used.



RECORDING DATA from oxygen recorder for process heaters

Summing up

• As industry continues to pile up experience with oxygen analyzers, results point to its wide acceptance as a third important combustion guide — along with steam-flow air-flow and fuel-flow air-flow.

• Flue-gas oxygen is a direct measure of excess air—key factor in maintaining efficient combustion. And it's not affected by type or quality of fuels burned. Oxygen analysis is making big gains in multiple-fuel installations. But even where plants fire a single fuel, nature of today's complex boiler often makes the oxygen analyzer a valuable member of the control system.

• Recent equipment improvements have come at a rapid pace. Problems that just a few years ago shook operator confidence in oxygen analysis are being licked. Today's analyzers successfully combat corrosion in the sampling system—even under toughest conditions. And they can get a truly representative sample. Maintenance needs have also been trimmed down substantially.

• New, reliable high-speed sampling systems, fast instrument response are big reasons why oxygen is catching on for automatic control as well as a guide to efficient combustion conditions.

POWER is indebted to the following manufacturers for supplying general information, technical data and illustrations used in preparing this report: Arnold O Beckman, Inc; Bailey Meter Co; The Hays Corp; Leeds & Northrup Co.

HOW TO ORGANIZE YOUR NEW POWER PLANT—20

Know the ins and outs of proper boiler start-up, operation, shutdown

- **16 points to check before starting up your boiler**
- **When to close vents, start automatic controls**
- **How to lay up a boiler for fast return to service**

By D C SWIFT, *Ebasco Services Incorporated*

► WHETHER YOUR BOILER installation is newly completed or has been in operation for a long time, your men must know how to start up, operate and shut down. Here are the details on these three vital procedures.

BOILER START-UP

Before firing a boiler, check the following: (1) Are all scheduled inspections and repairs completed? Have all "holds" on various parts of the boiler been released? (2) Are valves and auxiliary power circuits properly lined up, and readied for normal operation? (3) Drain and blowoff valves closed, and boiler filled with properly treated water to a level four to six inches below normal? (4) Additional pure feedwater and feed pumps for supplying it available? (5) Water columns and gage glasses cut in service, and steam-pressure gages checked to see they are turned on? (6) Are draft gages or flowmeters ready for service? (7) No one in the furnace or gas passages?

(8) Have all tools, scaffolding or ladders been removed? (9) All openings in setting and ducts closed? (10) Dampers tried for smooth operation and set in normal position? (11) Is fuel-firing equipment ready for operation? (12) Adequate fuel supply on hand? (13) Are pipes and valves to bring fuel to firing equipment filled and control valves in proper position for starting? (14) Have insurance carriers, safety inspectors or system-load dispatchers been notified, if required? (15) Are means for lighting the fire ready? (16) Vents on drum and drain on superheater and other low points in steam piping opened wide?

Purge the boiler thoroughly before attempting to start a fire, particularly on gas-fired units. An explosive gas mixture may have accumulated from leakage. After purging, reduce air flow through the unit to a low value, with furnace draft at 0.3 to 0.5 inches. It's good practice to send some but not all of the air through the burner to be ignited. Supply air required for combustion at velocities that will not blow out lighting torches or make it hard to ignite the fuel-air stream. A rich fuel-air mixture lights the easiest.

After turning on the igniter or inserting a large lighting torch in front of or slightly below point where fuel enters, start fuel flow. If the fire does not catch in a few seconds, cut off the fuel. Then thoroughly purge the boiler, and adjust fuel-air proportions to give a more readily ignited mixture.

Before lighting a second burner, see that the first is operating with a stable flame. As second burner is turned on, watch closely so you do not lose fire in the first one because of fuel pressure drop. Recirculating or using other means to steady the fuel-supply header pressure helps assure stable fires.

Adjust firing rate for a stable, essentially smoke-free fire without too rapid a rise in drum or superheater metal temperatures. Large high-pressure boilers are usually limited to a rise of about 100 F an hour because of temperature differences between inside and outside of drum, and its upper and lower portions. Thinner metal allows more-rapid temperature rise.

Check metal temperature with thermocouples peened into the drum, or estimate it from saturated-steam temperature corresponding to drum pressure. It's easier to note the rate of temperature rise if you measure with a recording instrument.

Superheater elements may overheat if firing rate is too heavy, and there is little or no steam flow through them. Superheater and burner location, amount of watercooled surface in the furnace, and steam vented through the superheater affect its permissible temperature limit. This is generally about equal to normal steam temperature.

Thermocouples peened into outer surface of the elements tell you the metal temperatures. Establish suitable firing rates and procedures from this information. Some units do best when upper burners are used. Water evaporates from superheater elements as quickly as possible, and while boiler surfaces are still cool. Other units require use of lower burners to raise boiler pressure so water is pushed out of superheater elements before they get too hot.

You can usually adjust rating of gas or oil burners to maintain steady firing. But to get a low enough average heat input, you may have to operate pulverized-coal equipment for only a portion of each 10- or 15-minute period. Some engineers use burner lighter torches for firing at first. This lets them avoid intermittent operation.

At 15 or 20 psi, close vents on drums and superheater header inlets so all steam generated is forced out through the superheater. This helps keep it cool. If steam-piping arrangement permits, have superheater pressure come up along with the boiler. This gives increased steam flow through the superheater and avoids temperature strains by warming the steam line gradually.

See that all piping being heated is well-drained, preferably bypassing the traps. As boiler pressure rises, inspect the unit at intervals. Check that expansion is occurring properly and that no leaks have developed on manhole or handhole gaskets or elsewhere. You may have to tap gaskets lightly or snug them up to obtain good seating and stop leakage.

As boiler warms, the water level rises. A short blowdown may be required. But as you vent an increasing amount of steam, the level drops, and you must add more feedwater. If unit has an economizer, feed enough water to avoid boiling or overheating there. Start firing with only a small amount of water showing in the gage glass. Bypass the air preheater, or operate it as facilities permit, keeping exit flue-gas temperatures up. This avoids corrosion-producing moisture deposits in preheater and dust collector.

For unit operation of boiler and turbine, start the turbine when boiler reaches one third to one half normal steam pressure. There are several benefits as follows. This procedure (1) avoids loss of heat and water otherwise required in draining steam off through the superheater (2) reduces total time required to start boiler and turbine (3) provides a means, on reheat units, for cooling the reheater.

But boiler should be at or close to normal operating pressure by the time you put turbine under load. The increased firing rate required to warm setting and raise pressure, along with that required to generate steam for turbine operation, sometimes results in excessive steam temperatures.

Safety valves may be lifted by hand before boiler reaches full pressure. The power-control relief valve on superheater outlet may be operated several times just before boiler picks up load. This helps clear water out of the loops of pendant-type superheaters.

If boiler feeds into a steam header, open stop valves shortly before boiler reaches header pressure. Then load pickup will be gradual and correspond to firing rate. (We assume that a check valve or stop-check valve is installed to prevent steam back-flow). If boiler pressure is materially above header pressure, open stop valve slowly to avoid a sudden rush of steam from the boiler. This may cause water carryover. See that all parts of the steam lead are well-drained to avoid serious shock from water hammer.

If the boiler serves one or more steam-using units alone, you have to rapidly adjust output to steam demand, to avoid undesirably large pressure changes. Bring turbine load up to 10 to 20% of full load and hold it there until the exhaust hood cools. This is ample load to cool the superheater, so you can shut off superheater drain line. You can also close trap bypasses and manually controlled drains on steam lines when lines are up to temperature.

Get additional burners and fuel supply for them ready, and cut into service as needed to maintain steam pressure. Increase air flow to match the increased fuel supply. Watch fires closely to see that you have a steady and fairly clean flame at all burners. Cut feedwater regulators into service as soon as they will maintain the boiler-water level properly. Watch steam temperature to avoid excessive superheat when load is first picked up. Too much combustion air, a deficiency of air or an excessive firing rate may raise steam temperatures too high. Ordinarily, adjust firing method and temperature control for minimum temperatures because some extra heat is still being taken to warm up setting and other boiler parts. Water may still be blocking some elements of the superheater, even though you are carrying a light load.

When steam temperature from representative elements evens out, showing that all elements are clear, you can safely increase load on the boiler. Follow a procedure established on the basis of preliminary tests, to clear the superheater of water in the shortest time that is safe.

Load pickup rate can be quite rapid so far as the boiler is concerned. Keep pressure close to normal to (1) assure a steady heat input and (2) avoid trouble with auxiliaries because of low steam pressure, or loss of steam and heat because of high pressure and resulting safety-valve operation. If you let pressure sag and then overfire the unit to bring it back rapidly, dangerously high steam temperatures may result.

Sudden load pickups may also cause rapid increase in boiler-water level. So it's desirable to increase the load in small, steady increments rather than in large blocks. As load increases, you can cut in additional burners. Keep air and fuel adjusted for approximately correct CO_2.

Inspect the furnace at each new load level to see that burners are all operating properly, and combustion is good. Time air and fuel changes as close together as possible. If you must adjust one before the other, let the air lead the fuel.

Use a similar procedure with stokers. Here you have more fuel burning, so fuel-air ratio cannot be changed as quickly except by changing the thickness and length somewhat, in anticipation of a load increase. This makes the load pickup easier to handle.

Feeding too much coal at one time may make the fire go black, or shut off air on front of stoker. On the other hand, if you increase air flow considerably with only a thin fuel bed, you may blow holes in the fire.

At 20 to 30% of full rating, you can usually put the automatic combustion control into operation. Watch it closely for a time to see that it functions properly. Close the bypasses and change back from special starting arrangements to normal operation.

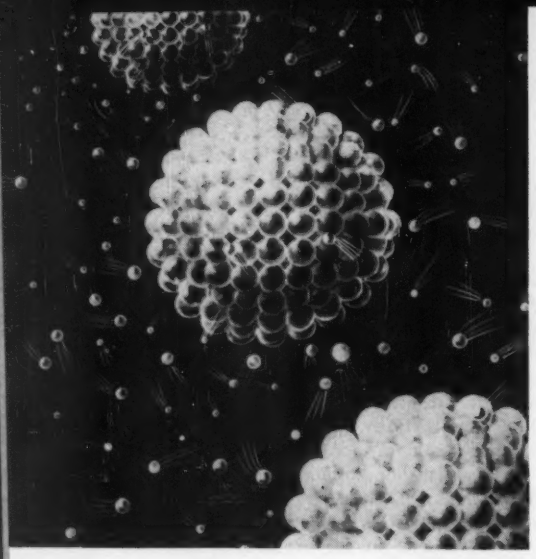
When load levels out at the desired rating, make a thorough check of all parts of the unit and its auxiliaries.

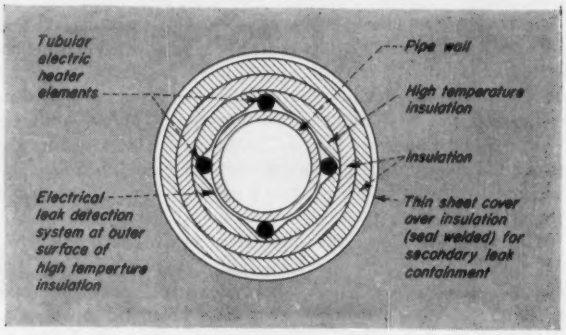
BOILER OPERATION

Record hourly readings from the more important instruments, and also record starting and stopping times for all important auxiliaries. Take readings to show draft loss, pressure loss and temperature change through various parts of the unit; check for unusual variations. Check steam flow-air flow or gas flow-air flow charts by periodic analysis of flue-gas samples. Check water-level indication at start of each shift and compare readings of the various gages and instruments at frequent intervals.

Operate soot blowers as needed—usually once a shift. Observe fuel and feedwater-reserve supply several times

(*Continued on page* 200)




Tubular electric heater elements
Pipe wall
High temperature insulation
Insulation
Electrical leak detection system at outer surface of high temperture insulation
Thin sheet cover over insulation (seal welded) for secondary leak containment

1 Piping carrying liquid metals like Na and NaK must be insulated, traced, have control protection, be contained

Just as in conventional steam plants, we find that many more systems are needed to make a nuclear power plant run than the main fuel and steam cycles. This month we take a closer look at . . .

Auxiliary systems for nuclear reactors

By **HENRY C SCHWENK**, *Henry Pratt Company*
and **ROBERT H SHANNON**, *United Engineers and Constructors, Inc*

► ONCE A NUCLEAR POWER PLANT starts running it becomes very difficult to approach the reactor vessels for inspection or repair. This situation calls for exacting design and fabrication procedures of these vessels. The design should eliminate stress concentration points and insure maintaining tolerances and alignment of all vessel parts. Stress build-up must be minimized during machining, welding and other fabrication processes; this includes holding down the number of preheating and stress-relieving operations too.

Accessibility will be improved by using removable parts in the vessel's internal structure, where possible, leaving only the primary vessel as a fixed part of the plant structure. The reactor-vessel materials must be properly chosen (see No. 13, POWER, Sept 1955); followed through by adequate inspection and quality control methods. The vessel subassemblies should undergo rigid inspection and testing.

Where transportation methods allow, most of the vessel should be built in the shop to avoid field-erection problems.

Make a thorough stress analysis of all reactor parts. This must be done for both steady-state and transient operation and include the heating effect from attenuation of nuclear radiations. Vessel design will be strongly affected by the coolant piping in respect to the number and size of connections and the forces and moments exerted on them by thermal expansion of both piping and vessel. Other important design factors are the fuel-element handling equipment, fuel-element decay storage facility, and reactor control equipment.

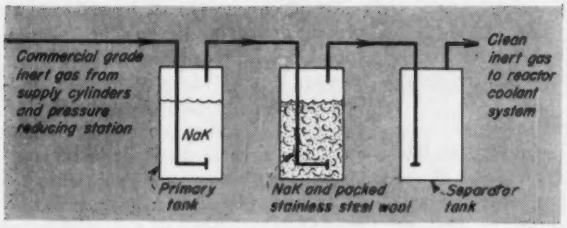
The reactor vessel has to withstand also the hydraulic forces set up by the coolant flow within its internal structure (No. 14, Oct 1955). Need for nuclear radiation shielding must be accounted for in the design.

FUEL HANDLING

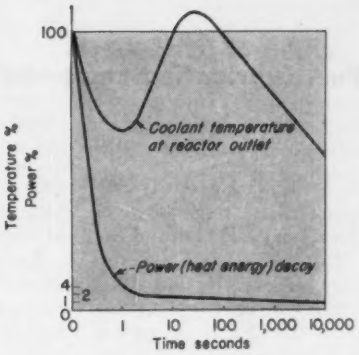
In homogeneous-type reactors, like the liquid-fuel design, processing for removal of fission products will require elaborate bypass extraction systems. Right now, the material containment for the reactor and coolant system raises serious problems because of corrosion and mass transport difficulties. While this reactor type may well be the "dark horse" of the future in the nuclear field—let us concentrate on the solid-fuel reactors in this article.

Equipment for inserting and removing fissionable and fertile materials in reactors must withstand severe operating conditions. Fuel-handling equipment may be operated as often as once a week or as seldom as once a year. Operating frequency depends on (1) nature of fuel material (2) neutron flux level (3) radiation damage (4) burn-up (5) corrosion and mass transport effects.

Solid-fuel handling apparatus must meet a wide range of requirements. Its design depends on the maximum length of element to be handled and the diameter of the reactor core and blanket. The coolant in the reactor will affect the choice of materials used in


Commercial grade inert gas from supply cylinders and pressure reducing station
NaK
Clean inert gas to reactor coolant system
Primary tank
NaK and packed stainless steel wool
Separator tank

2 Inert gases for various duties in nuclear plants must be cleaned to remove impurities when received from supplier



3 Heat production of reactor decays gradually when the plant is unloaded

the handling apparatus and the method of lubricating moving parts with close clearances (No. 13, Sept 1955).

Shaft sealing for drive-shaft penetration of radiation shielding may need long extension bellows or other schemes to eliminate escape of radioactive substances. The pickup or locking device holding the fuel element must be foolproof against accidental dropping during handling. Contacting, locking and pickup all have to be done by remote automatic control.

Drive, control and indexing devices must place element-pickup unit directly over each fuel element assembly for lifting and removal. The unit also has to align the new fuel elements over position, place in slot and release after lowering element in place.

The handling apparatus must transfer the spent-fuel elements from reactor to the decay-storage tank and pick up fresh fuel elements from fuel storage and insert them in the reactor.

The decay-storage tank will probably be filled with a fluid the same as the primary coolant. Spent-fuel elements stay in the tank until their radio-activity decays to a low enough value to allow transporting them in caskets to processing plants. The processing plants remove the fission products and recover the remaining fissionable and fertile materials. The decay tank may have to be cooled to prevent heat build-up from the radioactivity of the spent-fuel elements from the reactor.

REACTOR CONTROLS

We talked about controlling a reactor in No. 8, March 1955—now let's look at the design requirements. The basic types of control include: (1) regulatory (2) shim (3) safety (4) emergency. Emergency controls may be thought of as a fast-response type exerting a "last ditch" effort to prevent a reactor accident. It might be a fuse-type device in the core acting faster than the other controls.

Design of regulatory- and shim-type controls depends on many factors, such as (1) type of reactor (thermal or fast) (2) fuel alloy (3) percent burn-up (4) effect of fission-product poisoning (5) control-element material — poison or neutron absorber, movable fuel element, movable reflector (6) core physical arrangement (7) effect of *seeding* or *flattening* on neutron flux pattern (8) physical location of control elements in reactor—effectiveness varies about as square of neutron flux.

Control design also depends on maximum reactor temperature range and average reactor temperature during (1) initial fuel loading (2) steady-state normal operation (3) normal refueling operations (4) system thermal transients. These affect reactivity because of thermal expansion of the fuel, coolant and structural materials.

Regulatory and shim controls must compensate for burn-up, fission-product poison accumulation and temperature changes, as these affect the reactivity. These three factors, plus seeding and flattening adjustments and placement of control rods in the core, determine the need for movable control elements. The regulatory control handles normal operating load changes. Instead of this control we might be able to depend on the average temperature of the reactor core (fuel, coolant, structural) to handle normal operating load changes. If so, only shim-type controls would be needed to compensate for burn-up providing fission-product poisoning was not too great.

Safety controls shut down a reactor in a matter of seconds or less (scram) on the action of so-called normal scram signals. Regulatory controls, if used, can be designed to operate as safety controls. Special fast-release mechanisms quickly operate the individual rods. If only shim controls are used, enough additional rods of strong neutron absorbing material must be provided to satisfy safety scram conditions.

Control elements may be moved by (1) geared electric motors (2) hydraulic-piston systems (3) springs. These drives may be installed at either end of a reactor to move the control elements in the core. The controls must be designed to fail safe. When using fuel-element or reflector units for control of a vertical reactor, they enter from the bottom. When failing safe the units drop out of the core, decreasing the reactivity and shutting down the reactor. On the other hand, when using poison-type control rods they enter from the top of the core. When failing safe they drop into the core and shut the reactor down.

Control drives should be accessible for inspection, maintenance and repair since they must be in good operating condition at all times.

The amount of reactivity in each control unit should be less than that needed to cause the reactor to go "prompt critical." In No. 8 we learned prompt neutrons equal 99.25% of all neutrons released during fission; the remainder, 0.75%, are delayed neutrons. The term *one dollar's worth of reactivity* has been assigned as being equal to the fraction of delayed neutrons expressed as a decimal, 0.0075. Thus a value of reactivity equal to one dollar, $1, is that needed to theoretically cause the reactor to go prompt critical. The symbol ρ (rho) is generally used for the term reactivity.

The total negative reactivity in the scram controls depends on: (1) type and total number of scram-control units (2) physical location of scram units (3) desirability of minimizing reactor

Fuel fabrication costs—key to nuclear economy

shutdown decay heat removal (4) rate at which scram units are required to operate to insure safe shutdown of the reactor.

The primary safeguard against either power excursions or runaways of any reactor may be the change in nuclear cross section with temperature rise and resulting thermal expansion of (1) fuel material (2) diluent and alloying materials (3) reactor structural material (4) coolant, whether liquid, vapor or gaseous.

Every possible effort should be made to obtain a negative temperature coefficient of reactivity in designing a reactor. This means that, as the temperature of all the reactor parts rises, the reactivity is inclined to drop or become negative, tending to shut down the reactor. Any reactor having a positive temperature coefficient would be questionable from a safety standpoint. A rapid rate of decrease in temperature of coolant fluid entering a reactor should be avoided since this might cause a power excursion.

Control units in a reactor must be properly cooled to avoid binding and lengthen life. Scram operation of control units must be studied in their effect on coolant flow and displacement in the reactor. Design of control units is complicated by the pickup, latch or hold, and release mechanisms that must be incorporated. Materials of all parts of the control system must be able to withstand the exposure to radioactivity that they experience.

FUEL-ELEMENT FABRICATION

Fuel materials include U-233, U-235 and Pu-239, while fertile materials are U-238 and Th-232. After their reduction to metal from the original ore or reactor wastes they must be shaped into individual fuel elements. When these materials are radioactive, the fabrication becomes a complicated and costly process. Shapes of elements must conform within close tolerances to the reactor core in which they will be used. They must also fit the fuel-handling devices that insert and remove them from reactor, storage and decay pits.

All surfaces of fuel and fertile elements must be coated or clad with a noncorrosive material like aluminum or zirconium. Good heat-transfer bond may or may not be needed.

A certain inventory of reactor materials will be kept on hand for fresh-fuel storage and for radioactive decay of spent elements.

Personnel and plant safety must be carefully planned in laying out the fabrication and assembly processes of the fuel elements. Adequate inspection and quality-control procedures as well as testing after all major steps should be provided to insure satisfying nuclear and heat-transfer specifications. Design of a fuel-element-making plant depends, of course, on the type of fuel element to be made—how it is machined, welded, coated; how coolant passages are provided through unit, etc. For reactors using fertile materials, some fissionable elements may have fertile extensions on each end to provide equivalent breeder sections at the axial ends of the reactor core.

Spent-fuel elements are processed to recover (1) fissionable material (2) fertile material (3) marketable radioactive wastes; and to (4) concentrate radioactive wastes for storage and disposal. How and when fuel elements are reprocessed depends on the economics involved as well as the type of materials used, the amount of enrichment, the burn-up that can be achieved, and the radiation damage suffered by the individual elements.

The market for radioactive isotopes will probably grow in the future—future developments will tell the story. Disposal of radioactive wastes, a problem today, will grow more troublesome in the future. Concentration of these products to minimize handling problems is a must.

Fuel elements may be processed by (1) aqueous chemistry (2) metallurgical methods (3) combinations of the two. Plants to do this work are costly. Future development work, and one processing plant to serve many reactors will probably markedly reduce over-all costs—a must to make nuclear plants economically feasible.

This discussion of fuel elements includes also fertile elements used in converter and breeder reactors. The removal of cladding material used on all types of elements adds an extra burden in the processing of spent units.

DECAY-HEAT REMOVAL

If a reactor loses all power supply to its coolant pumps, the control system will scram it. Such an emergency shutdown does not stop the reactor from producing heat. The fissioning from delayed neutrons and the energy of the radioactivity in the core materials continue developing *decay heat*, which tapers off with time, Fig. 3.

The decay heat must be removed to prevent destroying the reactor. The accumulated heat can melt the fuel elements, cladding and structure of solid-fuel reactors or the containment and structural members of homogeneous reactors. If these basic parts of reactors can be destroyed, it is obvious that decay heat will also vaporize any coolant and completely boil away the water in a boiling-water reactor.

Amount of decay heat in a reactor depends on the negative reactivity $-\Delta k$ in all the control elements used in the scram operation. The decay heat also depends on reactor design and type, the power level and operating history preceding the scram.

Several methods can insure decay-heat removal: (1) Arrange coolant system so natural circulation carries off decay heat without exceeding maximum allowable temperatures in the reactor when completely losing pumping power. (2) Use standby storage batteries to run pumps when primary power is lost. (3) Use standby fuel-fired boiler and steam turbine-generator to supply emergency power.

Standby storage batteries should have small back-up diesel units with automatic starting to insure keeping batteries charged. This system is very expensive and needs variable-speed control for the pumps to stay within reasonable battery needs. Thoroughly explore natural-circulation cooling before deciding on a battery system. For reactor coolant flow paths shown in Fig. 2c and 2e, No. 14, Oct 1955, the battery standby would have to be used. Reversal of flow from normal to convection circulation after a scram would cause local overheating.

When using natural circulation for decay-heat emergency removal, several factors must be considered in the design: The heat exchanger, whether a boiler or an IHX, should be high enough above the reactor core to develop a big enough static head for natural circulation. We must know the relation of temperature rise from decay heat, static head available in the coolant system, net thermal head available for pushing coolant through system (reactor, piping, valves, fittings, heat exchangers and pumps).

The designer must also know the coolant-flow-decay rate following the loss of pump power, and the heat-decay rate following a reactor scram. He must study the flywheel-energy storage

of the coolant pump unit (the same for, say, a motor-generator unit supplying an electromagnetic pump). It may pay to increase the flywheel effect to better match the coolant-flow decay after a scram and so help avoid exceeding allowable temperatures in the system.

If the coolant can carry off the decay heat after a reactor scram, the next problem we meet is the removal of the heat from the coolant in the boiler. If we have lost the coolant pumps, we will also probably lose the boiler-feed and condensate pumps. To contend with this contingency, one scheme uses condensate storage tanks at a high elevation. Bypass lines and valves connect this tank to the boiler inlet header. The bypass valves automatically open on loss of pumping power, after automatic valves vent steam to atmosphere.

REACTOR-AUXILIARY SYSTEMS

All reactors need several types of auxiliary systems to perform duties varying from incidental infrequent operations to continuous functions. Though we have covered some of them in previous articles, let's now review.

Liquid-metal systems may use lead, lead-bismuth, sodium, sodium-potassium alloys as the fluid. Reactor plants must have receiving, unloading, storage, clean-up and transfer facilities to handle them. High melting-temperature metals may be shipped by railroad tank car, tank truck or drums. Sodium can be shipped in brick form in drums. NaK being liquid at ambient temperatures, except in extreme winter weather, can be shipped only in drums based on Interstate Commerce Commission regulations. NaK drums are returnable for credit, but Na drums are not.

The Na drums create a disposal problem for large systems. Usually about 2 to 4 lb of Na is left in each drum after draining. When delivered by railroad tank car, the buyer is charged only for actual amount of Na removed from the car. Heating equipment is needed for unloading. For tank deliveries, hot oil can be circulated through coils for melting and draining. For solid drums or bricks, electric mantle heaters or gas or oil flame heating can be used.

Oxides and trace impurities can be removed from liquid metals by filtering, chemical cleaning or, in extreme cases, by distillation of the metal. Na and NaK of the required purity as coolants may be available commercially. Micrometallic filters, stainless-steel-packed filters and circulating or diffusion cold traps can be used.

Pumps or inert-gas pressure may transfer liquid metals through the receiving facilities. The latter has marked advantages, especially if the liquid is radioactive. Sampling points on main systems help to check continuously on fluid purity.

Filling coolant systems with liquid metals must follow a careful procedure. For Na and NaK the entire coolant circuit must first be evacuated with a vacuum pump to remove all air. The circuit should then be purged with an inert gas, like helium or argon, cracking open all vents. After adequate purging, the liquid metal may be forced in to displace the purging gas.

If an overhead storage tank cannot be used to introduce the liquid metal, use pressurized gas for the transfer in preference to a pump. After filling, close all vents tightly. For initial operation it may be necessary to flush out the circuit thoroughly to obtain a completely clean system. Proper pitching of piping and elimination of pockets or low spots insures adequate venting and draining of the circuit as needed.

It may be impossible to drain some reactor vessels and fuel-element storage tanks because of elimination of low-point outlets to prevent accidental draining. Draining such tanks calls for special methods. All fuel elements would have to be removed from such vessels before draining.

Preheating of liquid-metal coolants must be provided for those with high melting temperatures. Preheating equipment and associated auxiliaries have to be installed in all piping, pumps, valves, heat exchangers, storage tanks, reactor vessels, fuel-element decay tank and associated apparatus. This heating is done prior to charging the circuit and during prolonged shutdowns of the reactor.

Several methods may be used for preheating. One circulates a hot inert gas through the empty coolant circuit. This requires a heater and large blower, and special interconnecting and isolating arrangements. This system can't be used when a liquid metal has frozen in the circuit.

A second method uses concentric pipes in the coolant circuit and circulates hot gas between pipes, the coolant being inside the inner pipe. While this design is expensive, the outer pipe also functions as a secondary containment. A similar scheme would use a hot-gas or steam tracer system.

A third method uses a low-melting liquid like NaK as a heating fluid. After draining the NaK the high-melting coolant would be forced into the circuit. Disadvantages of the system include the inability to completely drain the heating liquid from the circuit and the complicated interconnection and isolation arrangements needed.

A fourth method uses electric induction heating. This is good with ferritic-steel and stainless-steel systems. Special encasing piping, vessels, etc, must be used with ferritic steel. Stainless-steel systems require careful evaluation.

A fifth method uses tubular or strip-type electric-resistance heaters. This one requires careful planning to give maximum reliability. Factors to evaluate include: (1) voltage (2) maximum length of units (3) sheathing to protect heater elements (4) spare capacity to heat system if some heating elements fail (5) control circuit arrangement to allow heating even if one control circuit fails (6) heater arrangement to prevent localized overheating and increased thermal stresses—even with one heating circuit inoperative.

Insulating materials for radioactive zones and liquid metals were covered in No. 13, Sept 1955. Insulation should be chemically inert to the coolant. Other things being equal the designer must determine the type of insulation and the thickness needed for the maximum service temperature and ambient conditions.

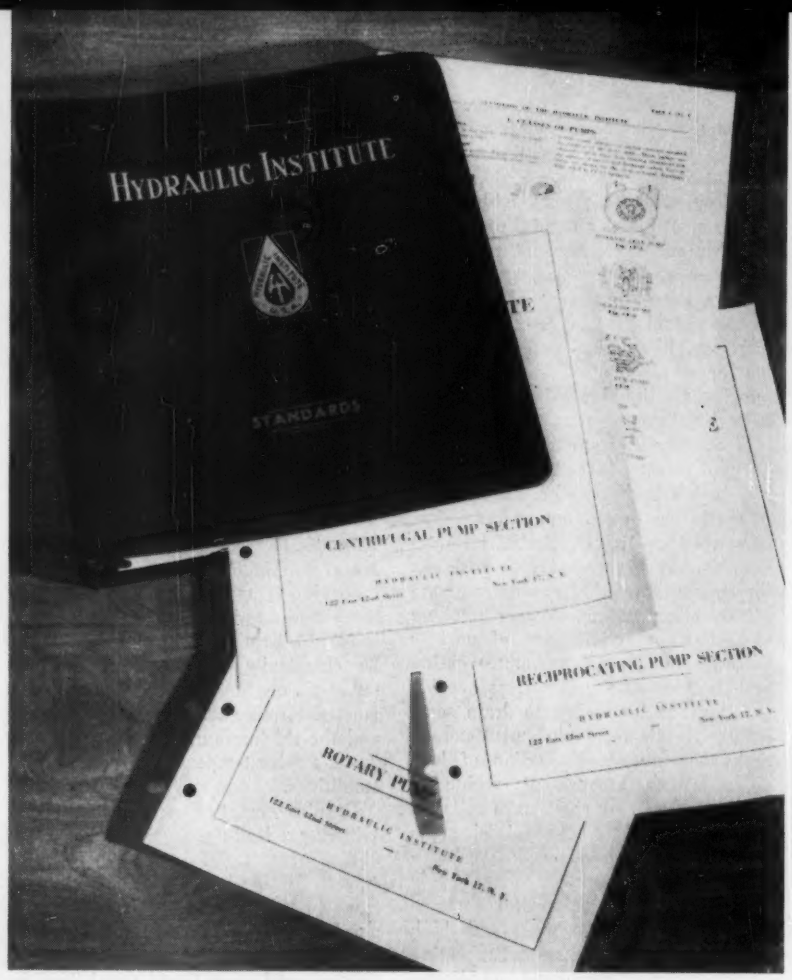
Despite every effort to design and fabricate a leak-tight system, the probability of material and weld failures exists. An electric circuit can detect leaks in liquid-metal systems. For example, a 2-wire system running the length of the coolant circuit will be shorted out by any liquid metal flowing across it and so sound an alarm. While used for horizontal piping runs, this method is not too practical for vertical runs. The main difficulty lies in reliability of the electric wiring and circuit controls.

As a safety measure, a thin sheet-steel covering around the insulation covering piping and equipment can provide secondary containment for leaks. A secondary containment vessel can be used for the reactor vessel. All sheet steel coverings would be welded and free to expand independently of the equipment. Fig. 1 shows a typical section of pipe with tubular electric preheating elements, a leak-detection system, insulation and sheet-steel covering.

Inert-gas facilities. Liquid metals expand as they get hot so some form of expansion tank must be used in the coolant circuit. Na and Nak burn easily in contact with air. This means that an inert gas must be used to cover the liquid metals in an expansion tank—or otherwise provide an expansion cushion. Argon and helium may be used for this duty.

To prevent oxygen, water vapor and other impurities getting into the coolant circuit a liquid-metal bubbler or clean-up system can remove traces of these

(*Continued on page* 213)



Hydraulic Institute issues latest Standards

► THE 10TH EDITION of the *Standards of the Hydraulic Institute* constitutes a complete revision and rearrangement of the format and the engineering data contained in earlier editions. Its publication culminates over two years of intensive engineering study and research to insure that the contents represent the most up-to-date consensus of outstanding pump engineers.

Contents. Much of this information is not published elsewhere because it relates to pump design, testing and manufacture. It is believed that the *Standards* now comprise the most comprehensive and authoritative engineering source devoted entirely to pump design and use.

This edition has five sections. The first contains general information about the Institute and a brief history of the series of publications preceding this edition.

Each of the next three sections covers a specific class of pump—centrifugal, rotary and reciprocating pumps. Each section is uniformly arranged to cover the classification, nomenclature, application, rating, testing, installation, operation and maintenance of one class of pump. As might be expected, the data on centrifugal pumps are the most comprehensive because these units find more use than rotary and reciprocating pumps. Of special interest is a comprehensive listing of part names and definitions in the centrifugal-pump section. Over 120 part names are included. These cover double-suction, multistage, end-suction, close-coupled and axial-flow pumps for both horizontal and vertical arrangements. Typical sectional drawings of these pump types illustrate the nomenclature.

Fifth part, called the Data Section, gives information on friction loss for water and viscous liquids in pipes, valves and fittings, as well as friction loss for paper stock in cast-iron pipe. Other data in this section include pipe dimensions, properties of water, viscosity of common liquids, and pump-construction materials for various liquids. The friction-loss tables, simply arranged for convenient use, are accompanied by examples illustrating their application.

Revisions made in the future will be automatically mailed to the user of this edition if he takes advantage of the revision notification service provided by the Institute. Each copy holder will be notified of all future revisions and may avail himself of the new material if he desires.

This 10th edition of the *Standards* and the recently published *Pipe Friction Manual* are valuable tools to pump engineers in every industry. Both are available at nominal cost, from the Hydraulic Institute, 122 East 42nd Street, New York 17, N. Y.

Power's DATA SHEET

No. 283

Area of type R-RH wire—stranded

Wire size	Number of wires in conduit								
	1	2	3	4	5	6	7	8	9
500Mcm	0.9834	1.9668	2.9502	3.9336	4.9170	5.9004	6.8838	7.8672	8.8506
400Mcm	0.8365	1.6730	2.5095	3.3460	4.1825	5.0190	5.8555	6.6920	7.5285
350Mcm	0.7620	1.5240	2.2860	3.0480	3.8100	4.5720	5.3340	6.0960	6.8580
300Mcm	0.6837	1.3674	2.0511	2.7348	3.4185	4.1022	4.7859	5.4696	6.1533
250Mcm	0.5917	1.1834	1.7751	2.3668	2.9585	3.5502	4.1419	4.7336	5.3253
4/0	0.4840	0.9680	1.4520	1.936	2.4200	2.9040	3.3880	3.8720	4.3560
3/0	0.4151	0.8302	1.2453	1.660	2.0755	2.4906	2.9057	3.3208	3.7359
2/0	0.3578	0.7156	1.0734	1.431	1.7890	2.1468	2.5046	2.8424	3.2202
0	0.3107	0.6214	0.9321	1.2428	1.5535	1.8642	2.1749	2.4856	2.7963
1	0.2715	0.5430	0.8145	1.086	1.3575	1.6290	1.9005	2.1720	2.4435
2	0.2067	0.4134	0.6201	0.8268	1.0335	1.2402	1.4469	1.6536	1.8603
3	0.1817	0.3634	0.5451	0.7268	0.9085	1.0902	1.2719	1.4536	1.6353
4	0.1605	0.3210	0.4815	0.6420	0.8025	0.9630	1.1235	1.2840	1.4445
6	0.1238	0.2476	0.3714	0.4952	0.6190	0.7428	0.980	0.9904	1.1142
8	0.0760	0.1520	0.228	0.3040	0.3800	0.4560	0.532	0.608	0.6840
10	0.0460	0.0920	0.138	0.1840	0.2300	0.2760	0.322	0.368	0.4140
12	0.0278	0.0556	0.0834	0.1112	0.1390	0.1668	0.1946	0.2056	0.2313
14	0.0230	0.046	0.069	0.0920	0.1150	0.1380	0.161	0.184	0.207
#6 Bare	0.027	0.054	0.081	0.108	0.1350	0.1620	0.189	0.216	0.243

Area of type TW wire—stranded

500Mcm	0.8316	1.6632	2.4948	3.3264	4.1580	4.9896	5.8212	6.6528	7.4844
400Mcm	0.6969	1.3938	2.0907	2.7876	3.4845	4.1814	4.8783	5.5752	6.2721
350Mcm	0.6291	1.2582	1.8873	2.5164	3.1455	3.7746	4.4037	5.0328	5.6619
300Mcm	0.5581	1.1162	1.6743	2.2324	2.7905	3.3486	3.9067	4.4648	5.0229
250Mcm	0.4877	0.9754	1.4631	1.9508	2.4385	2.9262	3.4139	3.9016	4.3893
4/0	0.3904	0.7808	1.1712	1.5616	1.9520	2.3424	2.7328	3.1232	3.5136
3/0	0.3288	0.6576	0.9864	1.3152	1.6440	1.9728	2.3016	2.6304	2.9592
2/0	0.2781	0.5562	0.8343	1.1124	1.3905	1.6686	1.9467	2.2248	2.5029
0	0.2367	0.4734	0.7101	0.9468	1.1835	1.4202	1.6569	1.8936	2.1303
1	0.2027	0.4054	0.6081	0.8108	1.0135	1.2162	1.4189	1.6216	1.8243
2	0.1473	0.2946	0.4419	0.5892	0.7365	0.8838	1.0311	1.1784	1.3257
3	0.1263	0.2526	0.3789	0.5052	0.6315	0.7578	0.8841	1.0104	1.1369
4	0.1087	0.2174	0.3261	0.4348	0.5435	0.6522	0.7609	0.8696	0.9783
6	0.0819	0.1638	0.2457	0.3276	0.4095	0.4914	0.5733	0.6552	0.7371
8	0.0408	0.0816	0.1224	0.1632	0.2040	0.2448	0.2856	0.3264	0.3672
10	0.0224	0.0448	0.0672	0.0896	0.1120	0.1344	0.1568	0.1792	0.2016
12	0.0172	0.0344	0.0516	0.0688	0.0860	0.1032	0.1204	0.1376	0.1548
14	0.0135	0.0270	0.0405	0.0540	0.0675	0.0810	0.0945	0.1080	0.1215
#6 Bare	0.027	0.054	0.081	0.108	0.1350	0.1620	0.189	0.216	0.243

How to find conduit diameter for wire sizes

Size conduit	Size hole	40% area	Area	OD conduit	ID conduit
1/2	15/16	0.121	0.303	0.840	0.622
3/4	1-1/8	0.213	0.533	1.050	0.824
1-1/4	1-3/4	0.596	1.490	1.660	1.380
2	2-1/2	1.341	3.361	2.375	2.067
3	3-5/8	2.960	7.403	3.500	3.068
4		5.090	12.720	4.500	4.026
5		8.008	20.002	5.563	5.047
6		11.560	28.890	6.625	6.065

Example: 2 #12 TW wires 0.0344 area
2 # 6 TW wires 0.1638 area
4 # 8 TW wires 0.1632 area

Total area 0.3614

40%-area column shows 1¼-in. conduit is needed.

JOHN M FRANKLIN *Hopewell, Va.*

© POWER

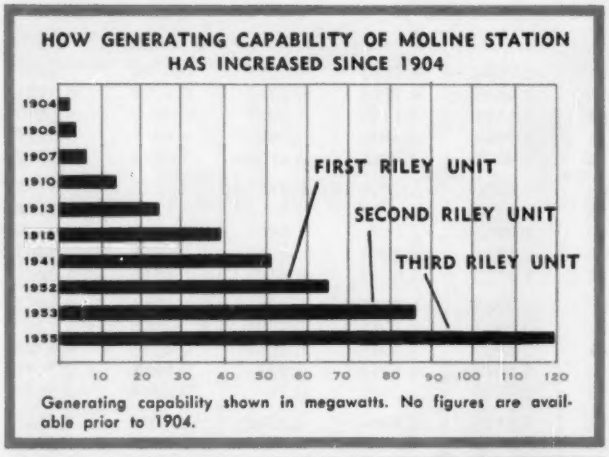
Another **POWER MODERNIZATION AWARD** featuring **RILEY Steam Generating Equipment.**

Iowa-Illinois Gas & Electric Company employs sound dollar-saving planning in modernizing its MOLINE STATION

retires ten old boilers - puts three RILEY

Results

1. **Increased plant capabilities from 53,000 kw to 119,000 kw.**
2. **Reduced heat rate 24%.**
3. **Cut kilowatt production cost by 2 mills.**
4. **Lowered plant per kilowatt investment from $131 to $113.**



SEVEN RILEY UNITS HAVE BEEN PURCHASED BY IOWA-ILLINOIS GAS & ELECTRIC COMPANY SINCE 1942

Riverside Station, Davenport, Iowa
1942—One 250,000 lbs/hr Unit—975 psi, 825 F
1946—Two 250,000 lbs/hr Units—1000 psi, 900 F

Coralville Plant, Iowa City, Iowa
1948—One 60,000 lbs/hr Unit— 500 psi, 730 F

Moline Station, Moline Iowa
1950—One 200,000 lbs/hr Unit—925 psi, 825 F
One 200,000 lbs/hr Unit—825 psi, 900 F
1952—One 250,000 lbs/hr Unit—975 psi, 905 F

Total Steam Generating Capacity — 1,460,000 pounds per hour

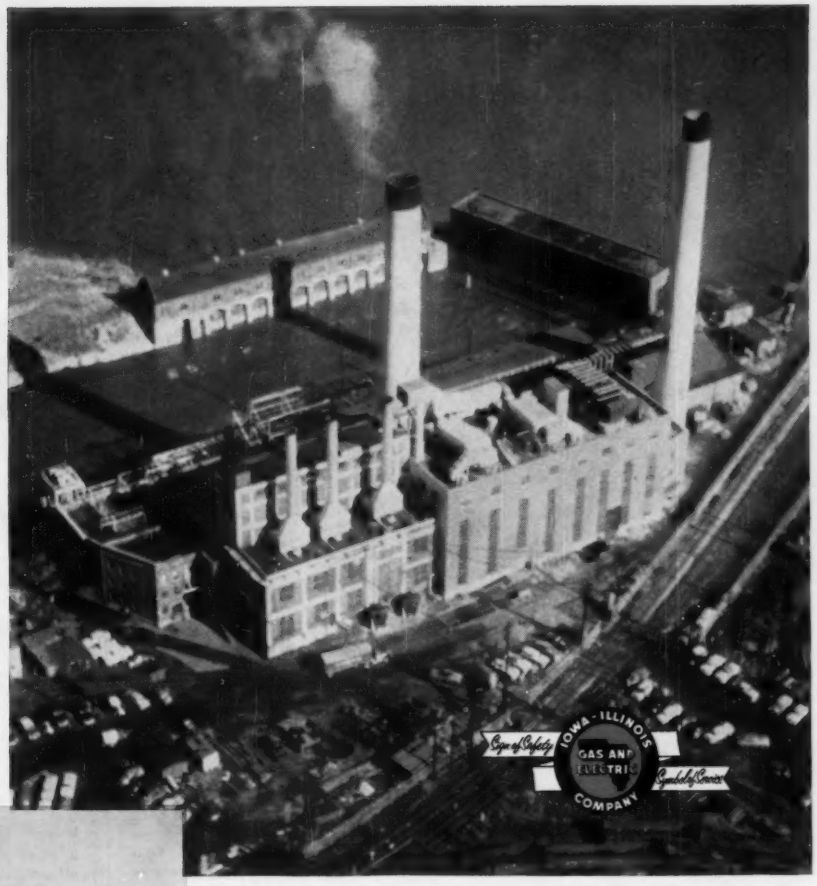
AS a result of a carefully planned two-stage modernization program, Iowa-Illinois Gas & Electric Company's Moline Station now is a modern 119,000 kw generating plant with high operating efficiency. Three Riley Steam Generating Units installed since 1951 have replaced ten old boilers originally installed in 1906. Teaming up with six retained units of the original plant the new Riley units are credited with substantially cutting kilowatt production costs, lowering heat rate and actually reducing the per kilowatt ratio of plant investment.

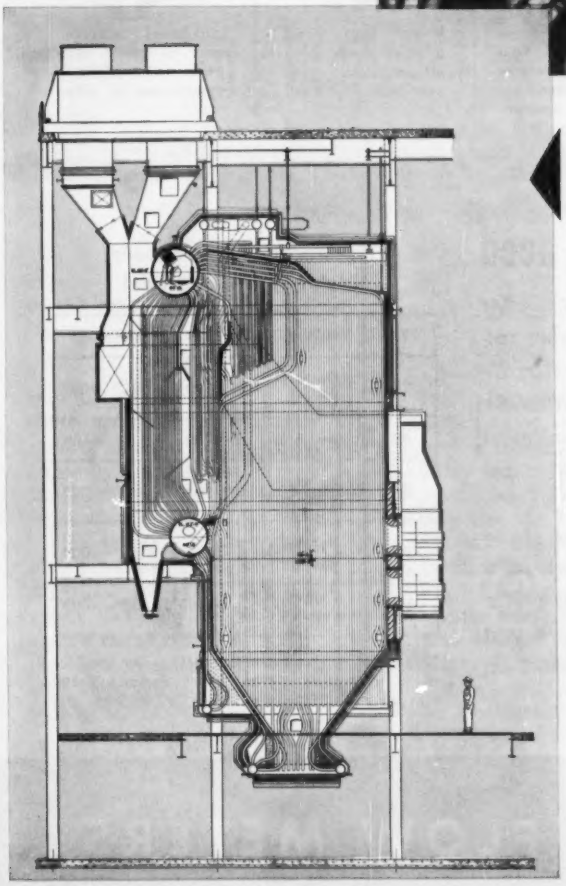
A further result of this outstanding modernization program was the winning of POWER Magazine's Modernization Award in 1954 — a tribute to the sound and realistic economic planning and engineering on the part of Iowa-Illinois Gas and Electric Company and its consulting engineers, Sargent & Lundy.

Moline Station serves the quad-cities of Moline, Rock Island, East Moline, Illinois, and Davenport, Iowa, and supplements the 140,000 kilowatts of the Riverside Station located at Davenport. Riverside Station has three pulverized coal fired Riley units each with a steam generating capacity of 250,000 pounds per hour.

RILEY designs, engineers, manufactures and erects complete steam generating

units on the line





THE third Riley unit installed at Moline Station operates at 250,000 lbs/hr at an efficiency of 88.4% with steam temperature at 905 F and pressure at 825 pounds. Six Riley horizontal flare type forced draft burners are installed for firing oil, natural gas and future coal. The increase in steam temperature from 825 F to 905 F decreased heat rate 2.6%.

A survey of your plant by a consulting engineer could show ways of making surprising savings in your power costs.

RILEY

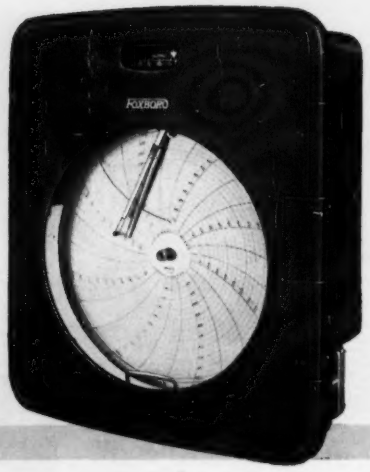
Stoker Corporation

WORCESTER, MASSACHUSETTS

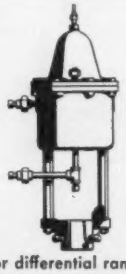
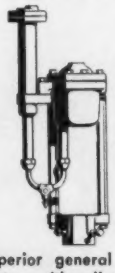
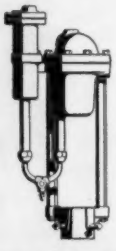
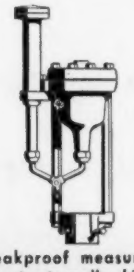
Sales Offices: Worcester, New York, Philadelphia, Buffalo, Washington, Pittsburgh, Cleveland, Detroit, Chicago, Cincinnati, Charlotte, New Orleans, Atlanta, St. Louis, Kansas City, St. Paul, Houston, Denver, Salt Lake City, Los Angeles, San Francisco, Portland, Seattle.

units for Public Utility Central Stations and Industrial Power and Heating Plants

What's worth metering is worth metering right!



. . . and Foxboro offers the *right* meter for any metering problem. Round and rectangular cases. Meter body types are shown below.

TYPE 22	TYPE 29	TYPE 27	TYPE 28	TYPE 26
				
light weight and low cost, preferred for portable recording, or with 6" indicator, for mounting directly on piping.	for differential ranges as low as 1" H_2O, especially for low pressure gas and air service.	superior general use meter with all Foxboro design features for high sustained accuracy and maintenance-freedom.	longer float travel, greater power, highest accuracy meter ever built.	leakproof measurement at really *high* pressures without compromise in accuracy.

a flow meter type for every need

From its complete line of flow meters, Foxboro can offer the *best* type — in the proper range and static pressure rating — for virtually any metering problem. They are available as indicators, recorders, controllers, and transmitters — with or without integrator. Foxboro also is the maker of the d/p Cell — the compact force-balance type flow transmitter which uses no mercury.

The widest selection of flow instruments is only one of the many factors responsible for Foxboro's acknowledged leadership in flow metering. See how this factor — together with many superior, exclusive design features — give you the most value for your money. Write for Bulletin 460-2 on mercury meters, Bulletin 420-2 on d/p Cells.

Specifications of Foxboro Meter Types Illustrated

TYPE	MATERIAL	MAX. W. P.	RANGES
22	Forged Steel	2000	20"–200"
29	Cast Iron	150	1" –10"
27*	Forged Steel	2000	10"–400"
28	Forged Steel	2000	50"–400"
26	Forged Steel	5000	100"–400"

*Type 27U is a uniform flow scale meter used for steam and other service where demand fluctuates widely. 100" range. Max. W. P. 2000 psi.

THE FOXBORO COMPANY, 681 NEPONSET AVENUE, FOXBORO, MASS., U.S.A.

FOXBORO REG. U.S. PAT. OFF. FLOW METERS

FACTORIES IN THE UNITED STATES, CANADA, AND ENGLAND

STEVE ELONKA
Associate Editor in Charge

Field-service engineer→ is your best friend, Mr Plant Engineer

By M E NORRIS, *Turbine Engineer*

► "SURE, we have a 30-megawatt turbine-generator that's supposed to be running late in 1956. But that 30 megawatts will be about 18 months too late," said the super of a small Midwestern utility.

"We expect a peak load of 60,000-plus kilowatts in '56, and we've only 52,000-kw capacity. But that's not what's bothering us. We're increasing our tie connections and that'll take up the slack. We have two new 15-megawatt units and two fairly new 6-megawatt units."

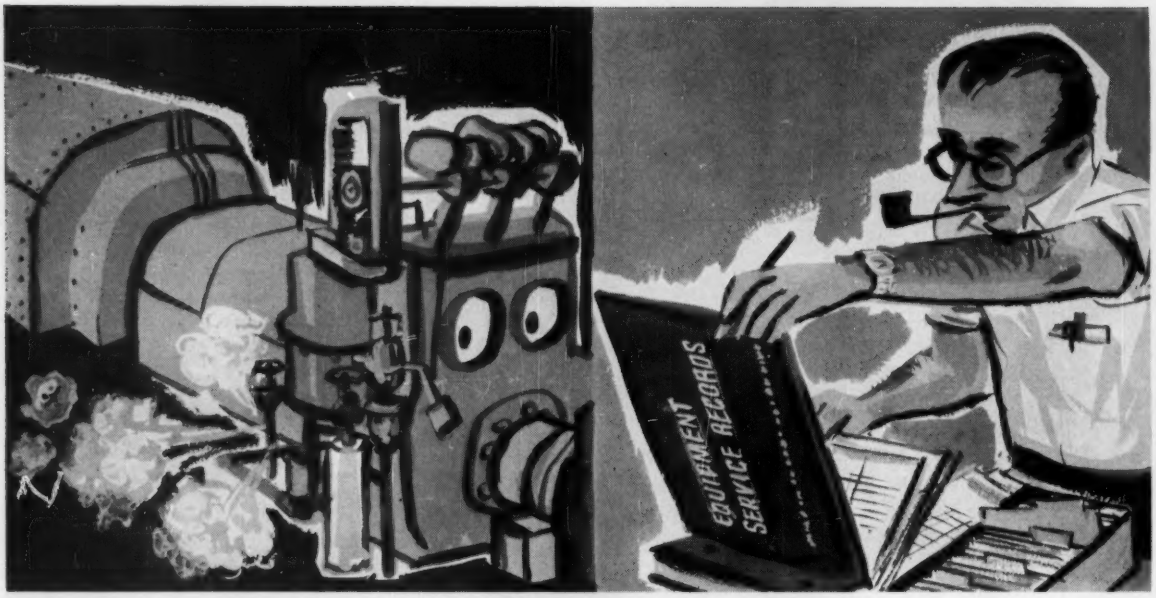
"But," continued the super, pounding his desk to each word, "we don't intend to wet-nurse 10,000 kilowatts out of that 30-ton pile of cast iron all summer long."

The "30-ton pile of cast iron" was a 10-megawatt unit that had been built in 1915. Installed originally somewhere in Louisiana, she had been purchased from a used-equipment concern by the utility in 1944. During re-installation, quite a few repairs had been made. At that time the unit was in fair shape. But in recent years she had been used for standby; started quickly as possible, run a few hours, then shut down. That was the story until 1954 when the summer demand soared beyond expected limits. Utility firm was caught short, had to depend on this 10,000 kilowatts for continuous capacity.

"That machine," complained the super, "is turning my hair gray." He explained they would overhaul the turbine-generator, put it in top condition. "She'll be used for medium and full load-service for the next six years. After that, she might again revert to standby."

This story is a composite picture of problems manufacturer's service engineers run into. The example is extreme, but it shows how a service engineer on local level, in district office and in factory can ease your job in meeting production demands. Point is that you plant engineers and superintendents must give uninterrupted service. Whether you have a single 300-kw machine or a million kilowatts, you want each customer to be able to melt his steel or burn his toast, as the case may be. Service engineer's job is to make your equipment reliable.

So this utility firm turned its problem of this 30-ton-pile of cast iron over to our firm. I christened her *Bertha*. She was no spring chicken, had seen 40 years of good and bad operation. Like many an old lady, there were



Bertha wheezed, moaned and groaned . . . so we looked up her case history . . .

marks on her hide that even a good coat of paint couldn't cover.

Before I arrived, our service division dug into files, came up with every known fault that Bertha had acquired in her checkered career. Bertha's water rate had been inching upward for the last 20 years. When forced on overload, she gobbled steam at an amazing rate. She would accept load reluctantly, then when asked to give it up, would sometimes drop it with a thud. Several times, for no apparent reason, she tripped out unexpectedly, taxing the already overloaded system. She leaked steam out of her shaft packings, threw oil on the floor. So Bertha was just an unpredictable old bag.

She was a 12-stage 1800-rpm condensing turbine with a direct-connected generator. There was no direct-connected exciter. We listed her faults: (1) Casing twist, causing unequal clearances around wheel's rim, had increased in last 20 years from a few mils to almost 1/16 in. (2) Shaft and diaphragm packing clearances were far in excess, causing leakage to atmosphere and between stages. (3) Buckets on latter-stage wheels were eroded and feather-edged. (4) Latter-stage diaphragm vanes were honeycombed and water-cut. (5) Casing-shell ledges and diaphragm-sealing areas were eroded and water cut, leaking steam between stages. (6) Governor, governor linkages, and governor drive were all three very badly worn, needed attention.

On credit side, Bertha had a few points in her favor: (1) High-pressure and midstage diaphragms were sound. (2) Turbine shaft was straight and true. High-pressure buckets were OK and so were all wheels and dovetails. (3) Bearings and bearing journals were fair. (4) Stator and field insulation was fair.

Plant engineer, superintendent and I decided that Bertha could be made a lady—if realigned and rebored. At the same time, we'd have to replace all shaft packings. She also needed several new diaphragms and rows of buckets.

Utility would use its own maintenance crew and foreman. They would work under my direction.

Dismantling started after I arrived at the power plant and saw Bertha in operation. She was torn down almost to her last bolt and screw. We dug high-pressure bearing standard out of concrete, then reset in alignment. Boring bar was placed in bearing standards and upper casing stripped of diaphragms, then bolted in place. Boring tool refaced casing ledges and smoothed out water cuts. Ledges were grooved and metal stripping installed in grooves.

We noted position of each diaphragm with relation to each wheel before complete disassembly. I had original wheel clearances supplied by factory. We repositioned each diaphragm with metal inserts. This brought all wheel clearances down to original drawing minimums. Old diaphragms were also grooved and supplied with inserts. In this case, inserts served as new sealing areas for old diaphragms. So Bertha had in effect new insides.

Meanwhile, worn buckets were stripped from turbine wheels and a crew drove new buckets in place. Here I passed along tricks I learned on previous jobs. At the same time, suggestions from crew taught me plenty.

Each day I laid out a schedule of work. It helped maintenance foreman assign his men. I worked with each group, giving advice when necessary, spending the rest of my time gathering needed information to use during machine reassembly. Decision for each change on Bertha was made only after comparing manufacturer's drawings with conditions found on job. Here again, I depended on my past experience with this type of machine and relayed data from our factory.

Neither Bertha nor the work done on her was unique. I met and solved some problems that had come up before—not just once, but many times, and I added improvements with each repetition.

So, bit by bit, hour by hour, Bertha was rebuilt. New packings, new bearings, new buckets, new diaphragms, new nozzles—all replaced with the utmost care. Old wheels and diaphragms were checked for cracks and defects by time-tested methods. Control valves and control-valve assembly were overhauled. Governor was completely rebuilt with

worked out a job schedule, and . . . **thus saved our client plenty of money**

new knife edges, new pins, new worm and worm-gear drive. Her entire lube-oil system was cleaned carefully and painted with an oil-resistant paint. Stator and field wedges were replaced and tightened, stator coil ties tightened. Stator and fields were repainted. Collector rings were checked and ground, field leads opened and inspected.

As work progressed, Bertha changed from an ornery old harridan into a respectable and reliable matron. She was started, and vibrational bugs balanced out. After that she plugged along every day, putting out her 10,000 kw. When conditions demanded it, she put out 12,000 kw at an acceptable water rate, too. She helped the utility firm over the 1955 summer peak, and will give them a nice margin for many years to come.

Question is, could the owner have done this unassisted? Could their engineering division have kept detailed and complete records on Bertha's operation? Could they have followed all the engineering, research and modifications in the turbine field for 40 years? Bertha's maker, who had thousands of reports on thousands of machines, sifted through these data, then used information to help Bertha in her old age.

Factory engineer you call to your plant has such information at his fingertips. He's a trained supervisor with technical knowledge, trained in factory and in field. In a few years he acquires not only factory's know-how, but picks up best methods from working with plant personnel.

He learns inspection and repair procedures that change, not with years but by the month. From old machinists and mechanics he gathers trade tricks that can come only with years of experience. He is a medium for exchanging information between plants with different conditions but the same basic problems.

The brand new machine in your plant is separated from a Bertha by only a few short years of neglect. Inspect your machines on schedule. From the first inspection to the last repair, call the manufacturer's field engineer. Enjoy the advantages that service engineering has to offer, regardless of equipment. My experience is that field engineers save you money, are a good investment.

What's wrong in burning combination of gas, oil

When burning gas from a gas gun at the same time with a center-fired oil gun, results aren't as good as when either fuel is burned alone. Various oil-burner firms have had the same experience.

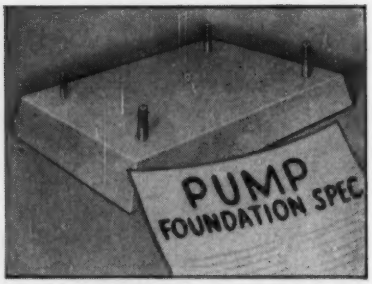
There's good reason for believing that gas from a gas gun might blanket the cone of sprayed oil from the oil gun. Then, air supply can't strike oil spray at point needed for producing a short and acceptable fire. That action explains why gas can be burned from an annular gas ring in combination with a centrally fired oil gun without combustion troubles. In this case, air stream is in a layer between two fuels.

It's best to use caution where gaseous and liquid fuels must be burned simultaneously. What's your experience?

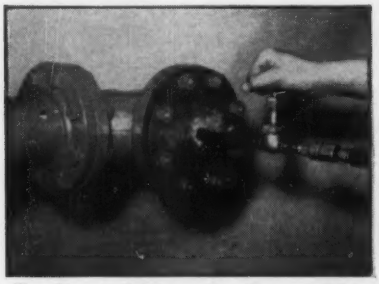
L V Andrews — *Worcester, Mass.*

Power-pump maintenance

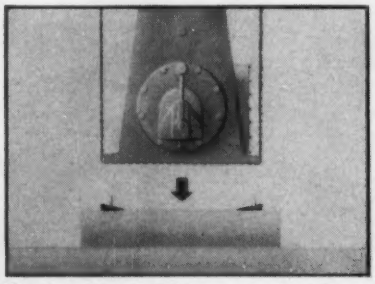
Here's a preview of a new power-pump maintenance film produced by Worthington Corporation for engineers and firms in every industry. Practical tips given in the film can go a long way toward making pump installation, operation and maintenance easier. For a complete showing of the film, contact Worthington



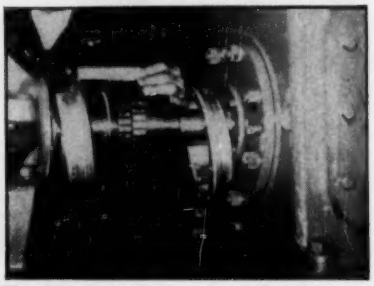
1 Check subsoil, then pour foundation, with its bolts, using maker's spec



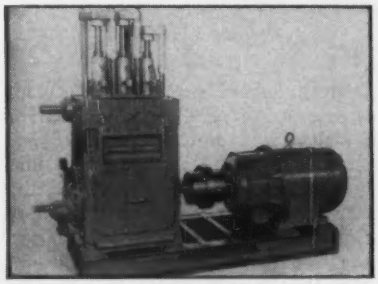
5 Clean all dirt and scale out of pipe before connecting the lines to pump



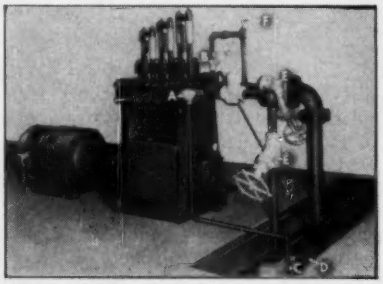
6 Set pump and driver on wedges; leave about 1 in. for grout under pump base



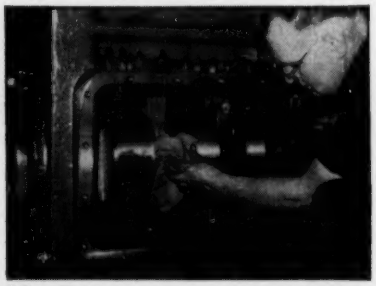
7 Check alignment of coupled drivers. Keep shaft centers within 0.002 in.



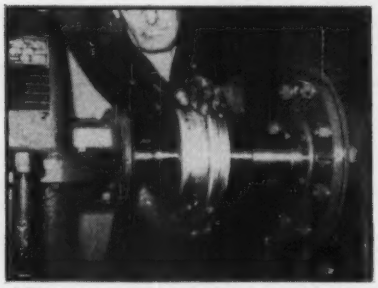
11 Don't think unit like this is ready to go yet; mount, align, run, check



12 Valves: *A*, relief; *B*, bypass; pipe *C* is a drain to *D*; *E*, stops; *F*, vent

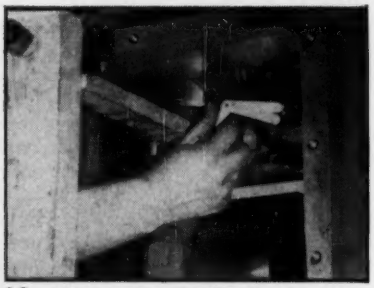


13 Clean pump; wipe dirt from wearing surfaces, crankcase; remove tags



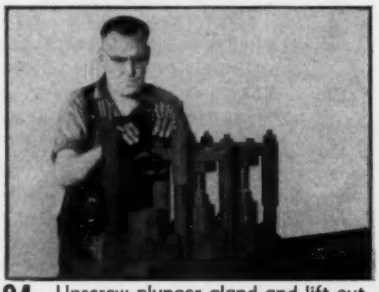
17 Turn pump by hand. It should move freely. Open suction, vent, bypass

18 Start pump; check lube pressure, feel frame. If over 150 F, stop pump



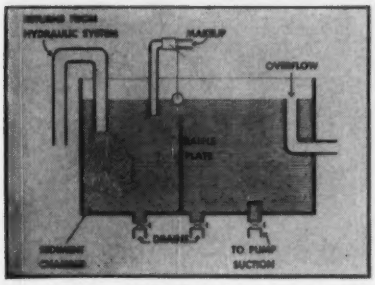
19 Hot-running crosshead may mean tight clearance. Check with a feeler

23 Don't tilt plunger when lifting it out. Hoist can be used on some

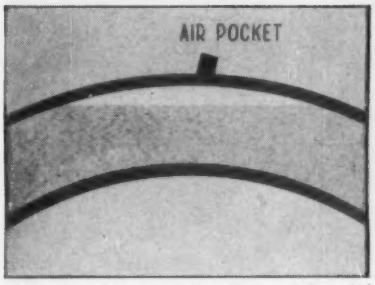


24 Unscrew plunger gland and lift out metal packing ring with draw rods

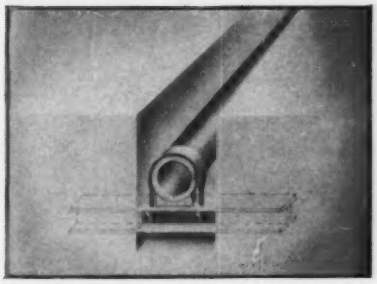
25 Turn pump by hand if packing is split-ring type. Prop gland, ring; oil



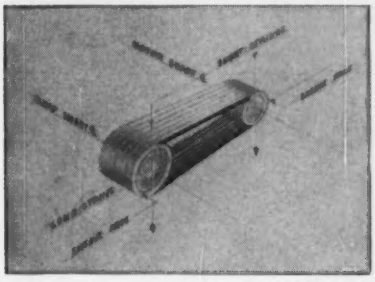
2 Use suction tank unless pump is supplied from a city-water pressure main



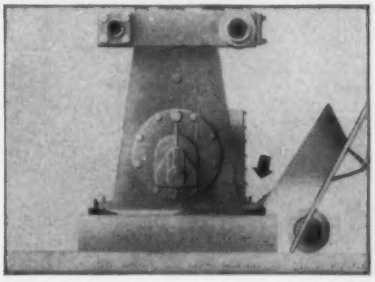
3 Use a big suction pipe and slope it up to pump to avoid pipe air pockets



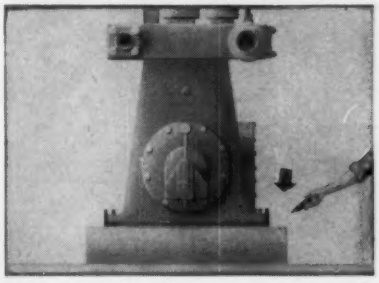
4 Support pipe with sturdy hangers at intervals to keep the vibration low



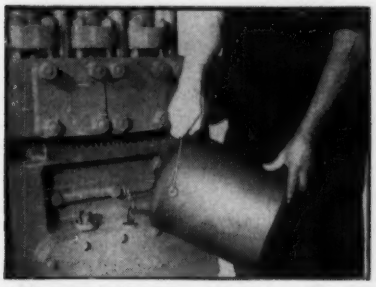
8 Use wires or strings to align a belt drive. All should touch sheave faces



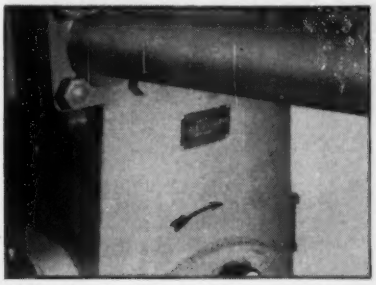
9 With wedges still in place, pour some grout under and around pump, driver



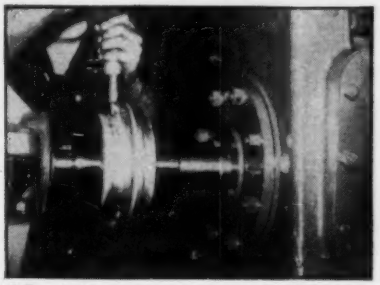
10 Before this sets, remove wedges and pour finish grout to the final grade



14 Add oil recommended by maker to the pump. Check grade, quantity

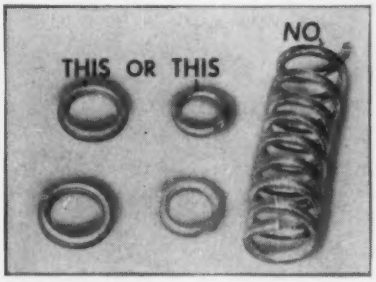


15 Check driver wiring so unit turns correctly; this is most important

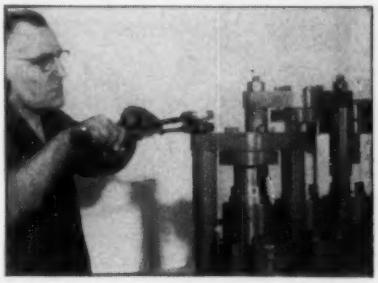


16 Add oil or grease to couplings, as maker directs. Check all pump bolts

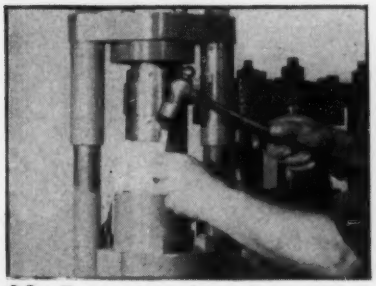
20 Most power pumps are shipped with the packing separate to protect rod



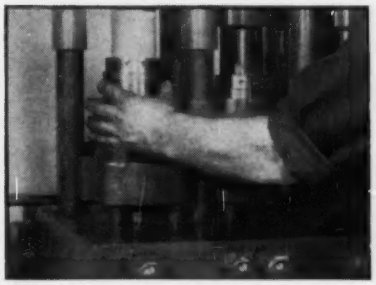
21 With solid packing, remove plungers. Never install in coil; use ring



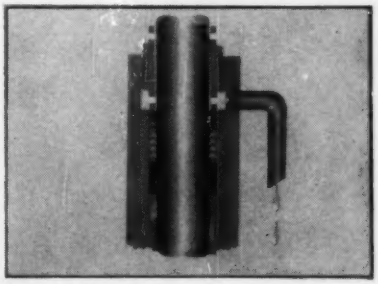
22 Use two wrenches to unbolt plunger crossheads from the side rods



26 Tap each packing ring gently in place with blunt tool. Stagger splits

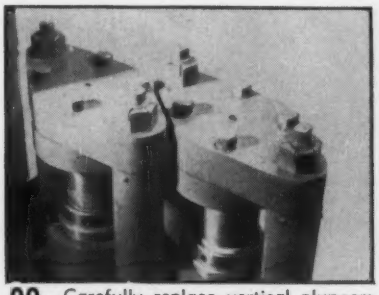


27 Lower ring and gland when last ring is in place. Tighten, back off

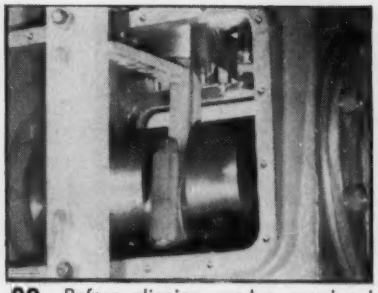


28 If V packing won't leak for lube use, remove rings until box runs cool

Turn page

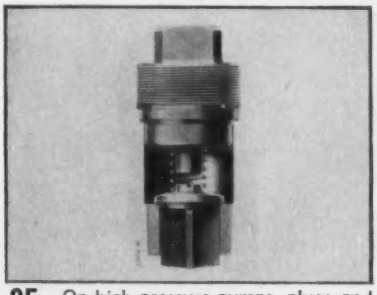


29 Carefully replace vertical plungers to prevent misalignment; use marks



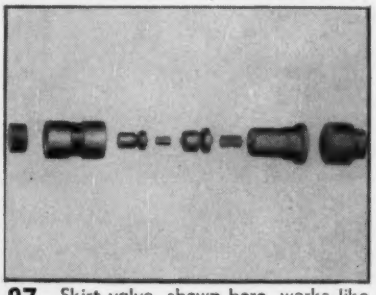
30 Before aligning, wedge crosshead on the normally loaded side of guide

31 Use calipers to check that each plunger is in center of stuffing box



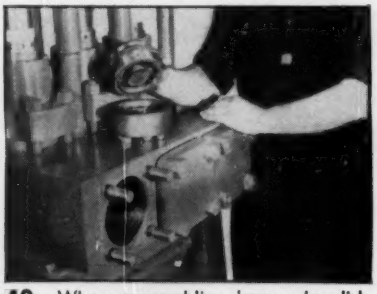
35 On high-pressure pumps, plugs and threaded covers hold wing valves

36 Slug home plugs with wrench and a sledge, even on a new pumping unit

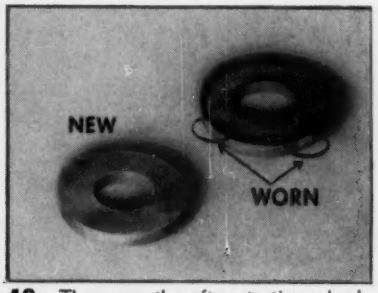


37 Skirt valve, shown here, works like a wing valve, has almost same seats

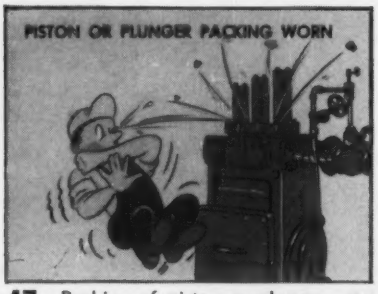
41 Valve assembly comes out of pump in one unit. Drive it loose with bar



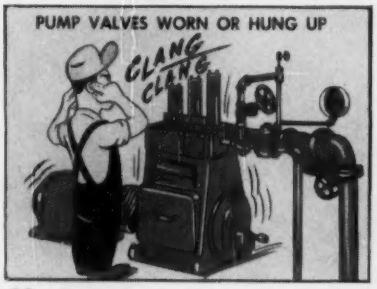
42 When reassembling, keep valve disk centered. Be sure to use new gasket



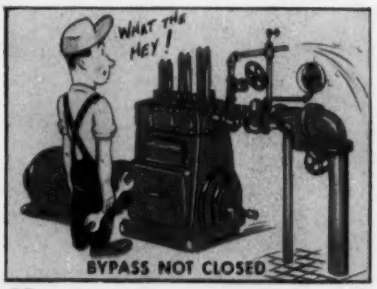
43 Three months after starting, check and replace the valves showing wear



47 Packing of piston or plunger may be worn, allowing leaks around it



48 Or pump valves may be worn or hung up, causing noisy operation



49 If the bypass is not closed, the pump will not discharge as it should

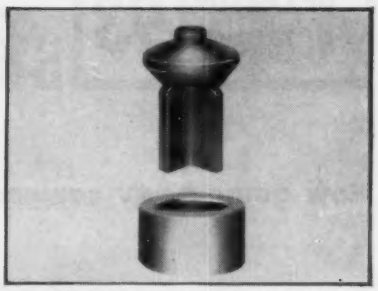
53 A poor foundation which allows pump to wiggle, jump, shake, rock

54 Misalignment also causes vibration of power pumps. Stop pump, align it

55 Poor suction conditions can lead to vibration in the piping and pump

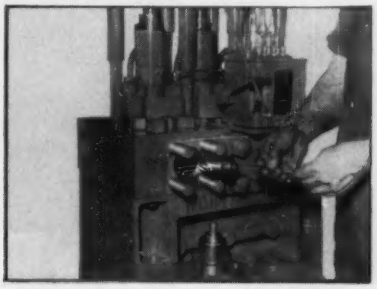
32 Soak packing over night before using it. This causes it to swell up

33 Peel duck and asbestos rings to get right length. Hammer braided rings

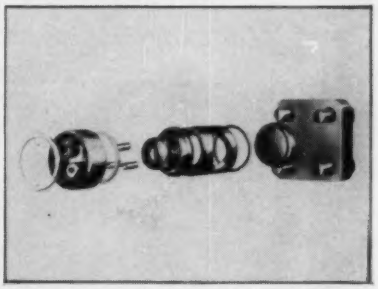


34 Wing-type liquid valve has a bevel seating surface and is self-grinding

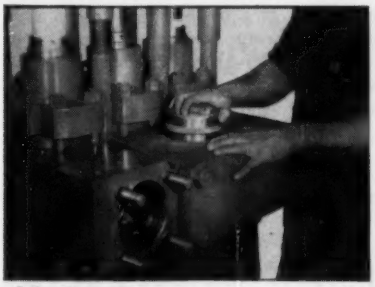
38 Pump with skirt valves has access holes behind seat for valve removal



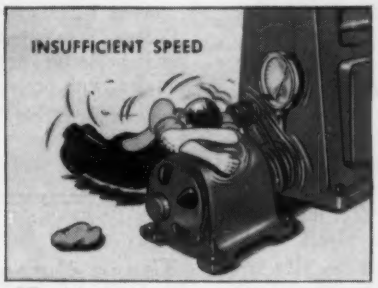
39 Use threaded rod to insert a skirt valve into the horizontal opening



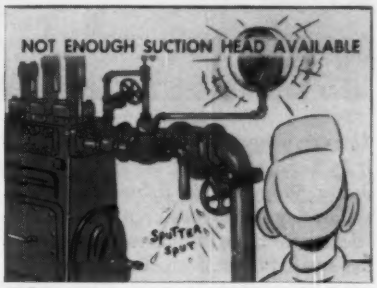
40 Ring- or double-ported type valve is being used on high-speed pumps



44 Reface valve seats on a grinding machine, if possible, or use emery

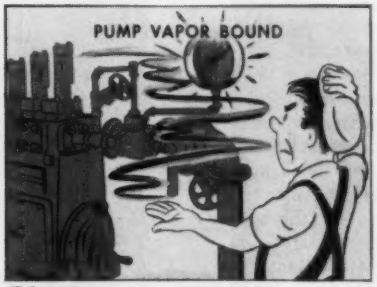


45 Now we'll review troubles: If pump isn't up to capacity, check speed . . .

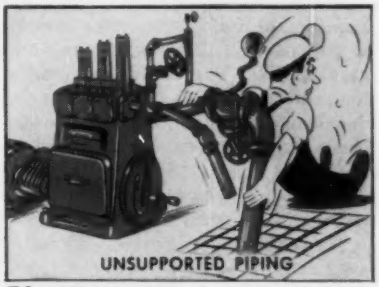


46 And for sufficient suction head to push the liquid into pump suction

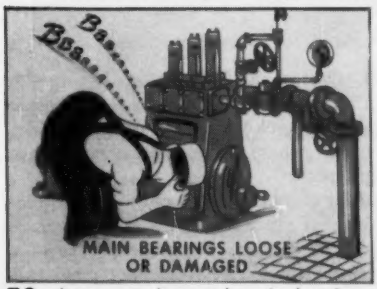
50 Internal gaskets may be damaged, as shown. Pump is noisy, shakes



51 If pressure won't build up, check for vapor binding, worn rings, etc

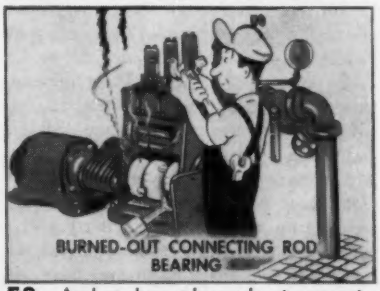


52 Vibration isn't always pump's fault: look for unsupported piping or . . .



56 Loose or damaged main bearings are another cause of the vibration

57 Too much crosshead-guide clearance means noise is excessive . . .

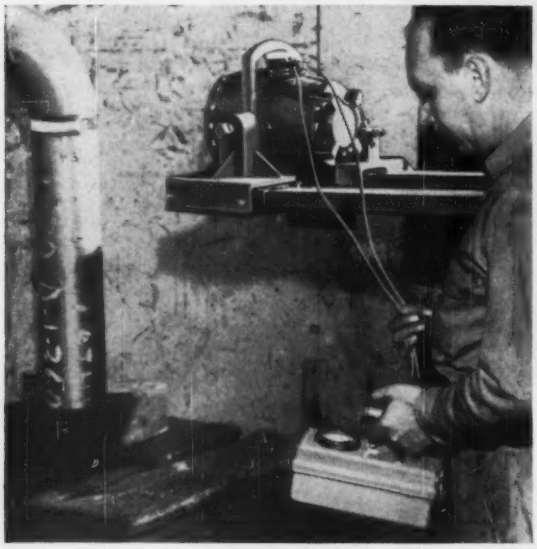


58 And so does a burned-out connecting-rod bearing in many pumps

OPERATORS' NOTEBOOK 93

Today, you see through metal

How gamma-ray camera works



You can mount this camera on lift truck or dolly, or carry it by hand to project gamma rays through metal to spot flaws. Support it in fixtures or hoists to find imperfect welds, flaws or cracks even smaller than 2% of material's thickness. Camera makes radiographs in places much too small to admit an X-ray tube. Yet gamma rays are powerful enough to make clear images through various metal thicknesses.

You don't need external power. When shutter is open a radioactive isotope inside the projector sends out beam of gamma rays that produce shadow images on photographic film. You can adjust beam's shape as a cone for spot shots on pipe welds, as a hemisphere, or as a doughnut ring for making complete 360-degree panoramas inside large pressure vessels and tanks. Gamma-ray projectors come in three sizes. The one you need may depend on dimensions and geometry of subjects to be radiographed, metal thickness you want to see through.

Three energy sources of different strengths are also available; as radioactive isotopes of cobalt 60, cesium 137 and iridium 192. Industrial life of these isotopes is 15 years, 80 years, and 7 months, respectively.

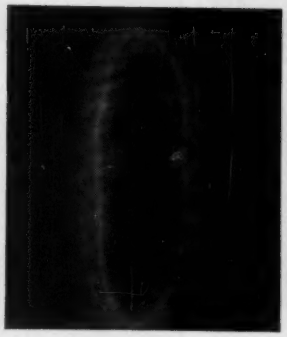
Intensity of energy source is balanced against service needs. That's why cameras are efficient for their purposes while reasonable in size, weight and cost.

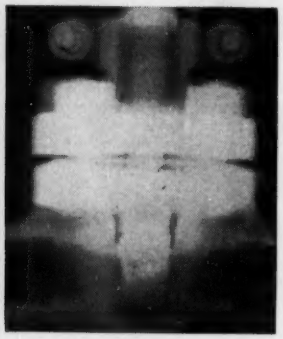
Exposures are short. Time depends on five factors: film speed, source, source strength, distance and thickness of material being radiographed. Slide rule helps to calculate each job's exposure quickly.

Compared with X-ray equipment that does comparable job, these cameras need no power source, are light, and require no maintenance during life of radioisotope. They are better on thick sections of metal, while X ray is better on thin sections. Exposure time depends on source strength and not on amperage and voltage.

Courtesy: Metal & Thermit Corporation, New York, N. Y.

Here's the inside story, and . . .

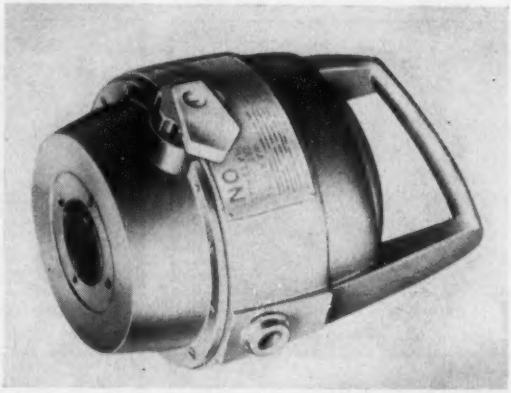




Both sides of butt weld in this 6-in. carbon-steel pipe show up on radiograph when "corona technique" is used. Corona results when pipe and projector are slightly angled, with projector about 2 ft from near side of pipe.

Penetrating heavy sections by gamma rays easily exposes parts and inner contours of this high-pressure valve for your inspection. Here, you quickly spot worn or weakened parts that may cause trouble. These shots are easy.

These three projector sizes give . . .



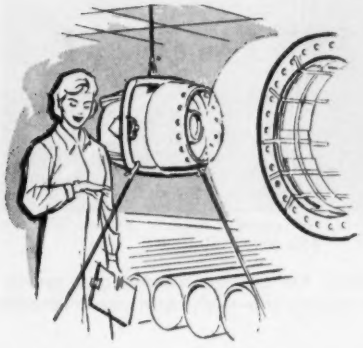
For easiest handling, choose smallest-size projector. It's portable and weighs 75 pounds. You can carry it up ladders and over scaffolding. It is quickly set up for shots in difficult places, as for welds where pipes are close together. Remove handle in tight places.

This model is useful for checking repairs to pipeline welds at widely scattered jobs. For pipeline work, just take camera to its fixture and open the shutter. During exposure of a given joint, you can remove the fixture from joint previously shot and relocate that fixture on next joint, thus utilizing operator's time and exposure time to the best advantage.

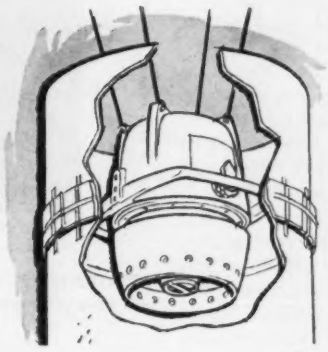
with a portable atomic camera

By STEVE ELONKA
Associate Editor

. . . this is how you use one of these new atomic cameras



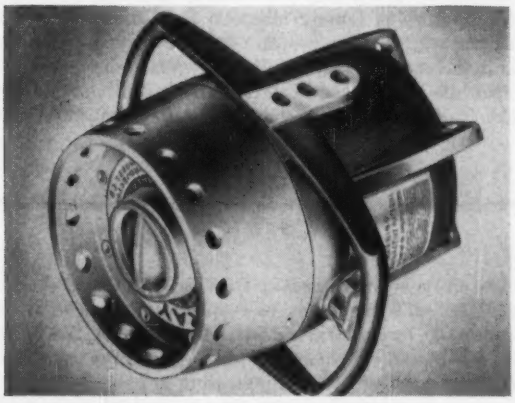
Flange weld. Using a cone pattern of radiation, the operator is making a spot radiograph of weld that joins flange section to pressure vessel's shell. Film, in packet, is taped behind the welded joint. Gamma rays from the projector pass through the metal and expose the image of weld on the film behind weld.



Panorama is 360 degrees. This time-saving setup radiographs entire circumferential weld in a single exposure. Projector is suspended inside vessel. Film is taped in position around entire outside circumference. In these shots, you can operate the shutter by remote control if that is more convenient.

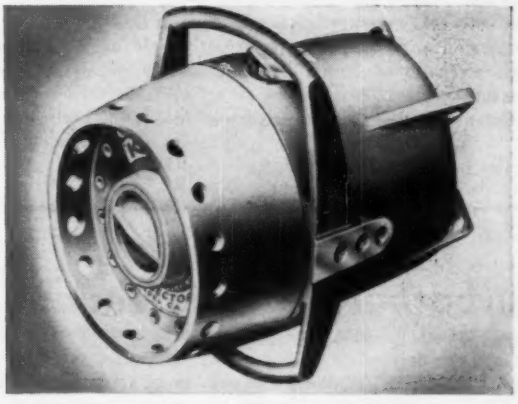
Circumferential weld shot. Here projector is positioned close to pipe. Rays pass through weld on near side, yet no image of weld on this side appears on film. Only weld on far side is radiographed. Variation is corona shot. By moving camera back and angling radiation, weld appears as ellipse on film.

. . . you sources of different intensity of radiation



This gamma-ray projector of medium size is more versatile, more powerful than the smallest one. You can adjust it to emit radiation in doughnut, hemispheric or cone patterns. With a 5000 millicurie source, holding capacity is 100,000 millicuries of iridium 192.

When using for pressure vessels, tanks and large diameter piping, place camera inside the work and make either spot shots or 360-degree panoramas. With iridium-192 source, you can radiograph 50-ft-diameter pressure vessels that are up to two inches thick in one exposure. Cesium 137 may also be used as the source in this projector model.

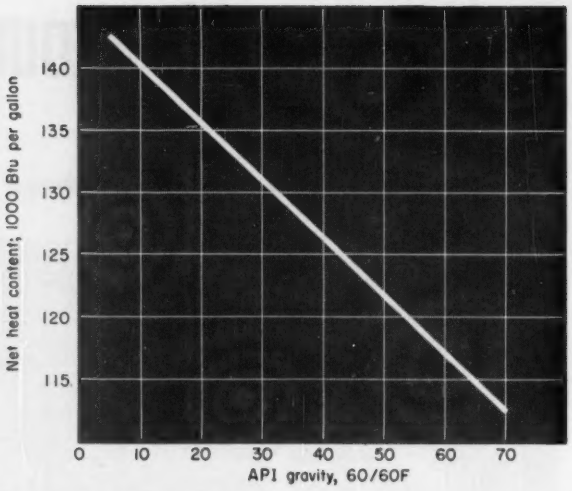


This largest size is for heavy-walled pressure vessels, pipe and heavy-fabricated fillet and butt-welded assemblies. Designed for use with a 50,000-millicurie source of cobalt 60, it easily radiographs 8-inch-thick alloy steel. Despite the penetrating power of its radiation, surface leakage is small, you can work near it all day, 40 hours a week.

You can also operate the shutter from a distance. It produces all three radiation patterns. This model is designed so for a quarter hour of rigging time you can radiograph the full rim of a storage tank or pressure vessel at one time. This cuts your labor cost per foot from dollars to mills.

Do you know your diesel-fuel specifications?

By PAUL D HOBSON, *State College, Pa.*



RELATIONSHIP of diesel fuel's heat content and gravity will save you money by showing how much power you can expect

► MOST OPERATORS know that their diesel fuel falls into some specification, but that's about all. And they try new fuels at times because the old one isn't available, or its cost has skyrocketed. These notes on effects of fuel characteristics may help you. Also, performance is often affected by some fuel elements that may not be specified.

Basic specifications. Most diesel fuels correspond closely to one of the grades listed in the table. These are a composite of commercial, ASTM and CFR specifications, but specs used abroad are similar. Domestic stove-oil specs are similar except no cetane is specified.

Grade 1-D is used mostly as truck fuel. Grades 4-D and No. 6 are marine and heavy-stationary fuel—grade No. 6 is a bunker-C type, requiring special treatment for diesel-fuel use.

Effects of characteristics. Flashpoint has no effect on performance. It tells temperature at which fuel vapors flash with a spark or flame. Specification is purely a safety measure.

Cetane number is the measure of fuel readiness to ignite in the engine. It's independent of flashpoint. High cetane is obtained by blending with paraffin hydrocarbons. This raises heat content per pound, but lowers Btu per gallon. Contrast 1-D (high paraffin) with No. 6 (very low paraffin). Most engines work better if cetane is not over 60; such high cetane is needed only for very light load and cold-weather operation. Few stationary engines run differently if cetane number is lowered to mid 30s, provided other characteristics are not changed too much.

Sulfur content may cause trouble. Sulfur in fuel burns to fairly harmless sulfur dioxide. If water vapor from exhaust condenses in engine, sulfuric acid forms. This is very corrosive. High jacket temperatures (185 F inlet minimum) prevent condensation in cylinder except at starting. Blowby gases may condense in crankcase, corroding engine parts and fouling lube oil. Good crankcase ventilation and high oil temperature help, but use special lube oils if fuel sulfur exceeds 0.75%. Special lube oils may be worthwhile at lower concentrations. Sulfur also seems to make fuel soot and engine deposits harder and more abra-

Turbocharger maintenance

By R F MIASKIEWICZ, *Elliott Company*

► WE DON'T AGREE with some statements made by C Morgan Jones in his article on turbocharger maintenance in Oct, pp 122-123. Sure, as far as general information on operation and care goes, the article is informative and correct. But since Jones used illustrations of only our turbocharger, POWER readers will think his advice is only for our equipment. If they do, some of his recommendations are not only inaccurate, but also if followed may be highly dangerous.

First, kind of failure he reports isn't likely to happen if you operate our turbocharger and engine as we instruct. Unless drop is instantaneous from full load and speed to zero speed, it's impossible to retain high exhaust-gas temperature at turbocharger during shutdown. Even if you must operate under those conditions, turbocharger won't fail if you have enough cooling. Here are suggestions:

Incline the water-discharge line upward to main water-discharge header or surge tank. This will vent jackets and circulate cooling by convection after unit is shut down. Or you might install a separate pressure source for this purpose. If you can't carry turbocharger water-discharge line upward to main discharge line or surge tank, place a vent valve at high point of line. That will prevent vapor lock or siphoning.

Just use common sense on items like keeping right coolant temperatures and following engine builder's advice. Author also says, "If turbo's lube tank is placed high enough above engine, with discharge pipe run to tank's top turbo's oil channels remain full of oil at all times." This is an impos-

Specifications of diesel-fuel oil

Grade		1-D	2-D	3-D	4-D	No. 6
Flash point, min F		100	100	140	150	200
Cetane number, min		40	40	35	30	—
Sulfur, % by weight, max		0.5	1.0	1.5	2.0	3.0
Ash, % by weight, max		0.01	0.02	0.02	0.1	0.1
Conradsen carbon, % by weight, max		0.15	0.25	0.35	—	—
90% distillation, F max		550	650	650	650	—
Endpoint dist, F max		—	700	700	700	—
Viscosity, ssu at 100 F	min	32	32	40	45	—
	max	—	45	65	125	400

Approximate characteristics not normally specified

Grade	1-D	2-D	3-D	4-D	No. 6
Net heat content, Btu lb	19,500	19,000	19,000	18,750	18,400
Specific gravity, 60/60 F	32 API	22 API	20 API	18 API	12 API
Net heat content, Btu gal	130,000	135,000	137,000	138,000	140,000

sive. This is often a major cause of wear, especially in smoking engines. High speed engines are more senstitive.

Nitrogen compounds (not specified), found in some Western fuels, also produce acid. Remedy is same as for sulfuric-acid formation.

Ash content is measure of care in refining. It's seldom high, except in some bunker-type fuels. High ash may result in abrasive wear direct and by causing hard soot to form.

Conradsen carbon is a measure of the deposit-forming tendency. It's not too critical in practice.

Distillation temperature is temperature at which given percentage of the fuel is boiled away. A 90% temperature, for example, indicates ease of vaporization in a running engine. Over 650 F means dirty combustion. Endpoint (total distillation) temperature, similarly, should not exceed 700 F. The 10% temperature is sometimes quoted. Together with cetane number it indicates starting quality. Over 500 F means hard starting even under ordinary temperature conditions.

Temperature of 50% is sometimes specified. Most fuels are OK on starting and clean burning if this is under 575 F, often termed mid-boiling temperature. Most other characteristics vary with mid-boiling temperature in practice, so comparison of fuels may be misleading if mid-boiling temperature varies widely.

Viscosity under 32 ssu at 100 F means that the fuel does not lubricate pumps and injectors properly and causes wear. Too high, over 125 ssu, means high pressures in pump and fuel lines. High pump pressures mean heavy wear, possible breakage. With some pumps, the barrel and plunger wear may be high. Limits of 35 to 60 ssu are safer.

Water and sediment limits may be specified. These may come from careless handling in transit and storage; refiner's specification may not mean much. So you must always filter or centrifuge your fuel before it gets to the engine. An additional very fine filter in the fuel-pump suction is most important. That's because grit wrecks a pump.

Heat content is most important. This may be quoted as gross or net Btu per pound or gallon. Gross heat content —sometimes called higher calorific value—includes latent heat of water vapor formed in exhaust. As this heat is not available in practice, net or lower heat content is more useful to the operator. Difference averages around 7% of higher calorific value. The fuels with high Btu per pound also have high API gravities. This means fewer pounds and less heat per gallon. Compare grades 1-D and 4-D. In practice, heat content can be related to gravity curve.

Pour point is rarely specified. If fuel must flow at low temperature, pour point should be at least 10 F below lowest ambient. Bunker-type fuels usually cease to flow before pour point is reached because of normal viscosity increase. In practice, high cetane means high pour point, unless additives are used.

Corrosive acids and gum-forming compounds should not exist in any good fuel. Gum-forming compounds may show up in domestic heating fuels.

Summary. Best fuel consumption is obtained with lowest cetane fuel of adequate volatility that the engine will handle. Domestic heating oil averages around 45 cetane, sufficient for normal service, but may go as low as 20. Higher cetane is important only for cold starting, should not exceed 450 F for this service. Remember pour point for it can save you a lot of headaches.

Other characteristics are normally kept within reasonable limits by standard fuel specs. Oil and sediment are an exception, so centrifuge or filter your fuel for best results.

---

sible hookup as tank top (or crankcase) must be below turbocharger oil-drain connection. There is an atmospheric pressure and gravity-flow oil-drain system.

Turbine blades. Here, Jones gives some dangerous advice for our machine. For example: (1) Our turbine blades are *not* tied together at tips. (2) Wire is *not* soldered to blades. (3) Damping wire flats are *not* from filing to balance rotor.

POWER readers should know that improper handling of any rotor assembly can be very dangerous. It's a high-speed high-temperature machine that is perfectly safe if handled right. If you must do anything but cleaning or routine inspection that's not covered in your instruction book, always return the turbocharger to maker for repair.

Damping wire that spans a blade group near blade tips is loose and it must stay loose on our rotor to be effective. That's why blades and wire are not joined rigidly. And solder would never be used for temperature and stresses in these rotors. Just because wire is loose in the blades, don't expect it to slide through blade holes with light pressures. We suggest that you leave wire position strictly alone. Never, *never* file, nick or deform the lashing wire. Extremely high forces exist in such wire segments during operation. So weakening their structure may wreck turbine stage. Flats on individual wire ends of our turbocharger serve a purpose.

As turbine wheel heats and accelerates to high rotative speeds, the linear span across a blade group becomes greater. But the wire is bowed outward between each blade supporting-hole from centrifugal force when turbocharger operates.

Wire must be longer than blade span to compensate for: (1) arc-length increase due to blade centrifugal force (2) decrease of wire chord length due to bow. When cold, uniform wire segment between upset ends are slightly longer than needed to span blade group. Ends are flattened to prevent permanent shifting of wire in a single direction.

SALVAGE of mechanical-transmission parts was high at Farrel-Birmingham plant, following floods on August 19 and October 14

What one plant learned from the floods

► WHEN A FLOOD STRIKES, you are going to have cleaning and salvage problems as soon as the water recedes. Just how difficult the problems will be depends on how much water gets into your plant, how long it stays there, what you are able to do beforehand to minimize damage, and how fast you can start salvage work.

To give readers the benefit of the experience of one plant that was hit by unprecedented floods last summer and fall, POWER visited Farrel-Birmingham Company's Ansonia, Conn. plant.

Talking with Bernard Didsbury, superintendent of the machine and erecting shop, and Elvin Lockwood, manager of the maintenance department, disclosed that many things can be done to help. Here's their story of what happened, what they did and how they will cut damage in future floods:

Farrel-Birmingham has two plants in the Naugatuck Valley in Connecticut—one in Ansonia, the other in Derby. Both cities were severely stricken in the flood of August 19.

This flood was so unprecedented and unpredicted that no one in the valley was prepared. Water rose so fast and so high that it was impossible to dismantle motor and electrical controls. Over 500 motors were in need of complete overhaul after the water receded. Many machine parts in the erecting shop that had been ready for installation now had to be salvaged.

At Derby, flood damage was less extensive than at Ansonia. But at Ansonia, where the river rose to 43 feet—10 feet above any previously recorded level—the company's office, engineering department, foundry, main machine shop and some other shops are on fairly high ground and, fortunately, were not damaged at all by the water.

The water level dropped rapidly. This was a great aid to quick salvage effort even before mud and debris were cleared.

Clean-up work started almost immediately. The flood crested at about 2:30 pm on August 19; clean-up operations began by 8 am on the 20th. Our erecting shop had been under nine feet of water, the roll shop under 12 feet. Yet salvage ran close to 100%.

First step was cleaning up the mud from the flooded areas. This was vital from two standpoints: mud was polluted and thus a menace to health; also, it hindered every other movement we wanted to make. The mud lay two feet deep in some spots.

Heavy boots and gloves were available as early as 8:30 am on the 20th, and a stream of deliveries of raincoats, hand lamps, shovels. pails, brooms, disinfectants. solvents, lubricants, etc, followed.

The dispensary furnished typhoid shots for all workers. Emergency supervisors' meetings held at least once daily kept confusion to a minimum, established areas of responsibility, let everyone know what everyone else was doing, what equipment had been ordered, when it could be expected.

We obtained portable generators, trucks, scoops, bulldozers, payloaders and mobile cranes on fast delivery.

Suppliers generously rushed equipment and personnel to assist in recovery. Other suppliers did quick reconditioning jobs on equipment sent back to their plants.

We rented auxiliary power units and portable compressors. First uses for auxiliary power were limited crane service to assist in disassembling, power for the foundry core-drying ovens that were used to dry out motors, and emergency lights for the areas around the ovens.

Lights were a critical factor. Without them, the men could work only one shift. It took ten days to get a temporary lighting arrangement set up for 2-shift work in the machine shop.

The plant got back into limited production by September 7. This was only a few weeks before the second flood, which hit during the week end beginning October 14.

The second disaster brought destruction and grief to many, but to the company itself, the damage was not comparable to that experienced in August. Water in the shops totaled inches rather than feet. And there was less pollution, very little silt. In addition, the plant was much better prepared. Before areas became flooded, there was time to lift out of danger motors and controls, as well as many other machinery components. We got back into production within a few days.

While there is no reason to expect continued flood damage in the future, the company is taking precautions against any possible flood recurrence and making some long-range plans for greater protection.

Here are details on some of the salvage operations, and on the long-range plans:

Bearings and gears

We followed these general steps in salvaging mechanical parts like bearings and gears: (1) Clean off the outside casings. (2) Dissassemble. (3) Get mechanical parts into anti-rust solvent and clean off caked silt, contaminated grease, etc. (4) Remove rust. (5) Dry. (6) Regrease. (7) Clean casings (generally with steam). Repaint if necessary. (8) Reassemble.

Crocus cloth buffed rust off the bearing balls and races. When this treatment left only a slight discoloration, but disclosed no pitting, bearings were deemed OK for reuse in plant machinery.

All new bearings for customers' equipment went back to manufacturers for reconditioning or replacement. And all sealed bearings for motors were replaced with new ones, since the wearing surfaces are not accessible.

Sleeve bearings were no problem. After cleaning they went back into the equipment.

Here's an interesting point about the bearing salvage: The flood water had a high acid content that badly corroded antifriction bearings made of case-hardened carburizing steel. Almost all these bearings had to be sent back to the manufacturers for reprocessing. But most of the through-hardened alloy-steel bearings had only to be flushed out and relubricated to put them into condition for reuse.

We used various pastes and solutions to remove rust from the gears, then coated them with water-disbursing protective oil. This treatment put them back in business if dimensions hadn't changed seriously.

Salvage crews had to clean both open and enclosed gears. The water and silt got into sealed units through the shaft oil seals. These seals do a good job of keeping oil in, but have almost no effect in keeping water out.

Other equipment

For shafts and other steel parts, salvage procedure is much the same as described above for bearings and gears.

Rubber power-transmission belts were cleaned off with cold water, hung up to dry. Salvage was almost 100%, as the belts didn't stretch or crack.

Oil lines were cleaned by blowing out with air or steam, then flushing with solvent until it came out clean.

Machine sumps were drained as much as possible, then steamed to remove the rest of the dirt.

Hydraulic transmissions went back to the manufacturers for reconditioning. This freed plant men to work on machinery they were more familiar with.

Motors and controls were one of the biggest headaches. They had to be cleaned, thoroughly dried and checked before reassembly. This takes time—particularly for drying—and you can't hurry it. We set up a motor-cleaning and repair station in the foundry. Washing and steam-cleaning operations went on in the yard. Units were dismantled and tagged inside the foundry, bearings and shafts cleaned and oiled as outlined above. Then stators went into the core-drying ovens for the slow process of drying out at about 225 F.

After drying we checked insulation resistance with megohmmeters. If reading was up to minimum safe value recommended by the AIEE, unit was reassembled. The work of drying out motors went on a 2-shift basis during the entire clean-up operation.

We put some electric controls back into service without drying them out. This was strictly an emergency measure, and required frequent coil replacement.

Current transformers in our high-voltage switchgear all had to be replaced. They failed even after drying and insulation resistance checks.

Ovens lined with firebrick were dried out with slow heat. This prevented cracking, eliminated any need for rebricking.

Before another flood hits

To cut down on damage and speed up salvage work in any future flood, Farrel-Birmingham is working out an emergency program. The chief points, related here by company president Franklin Farrel 3d, could also save money in your plant.

Since salvaging electrical equipment is by far the greatest bottleneck, we are educating all machine tool operators to disconnect, unbolt and tag the motors and controls from their machines if there's a flood. Cranes will then move them to higher locations. When salvage work begins, the operators will reconnect their motors and controls.

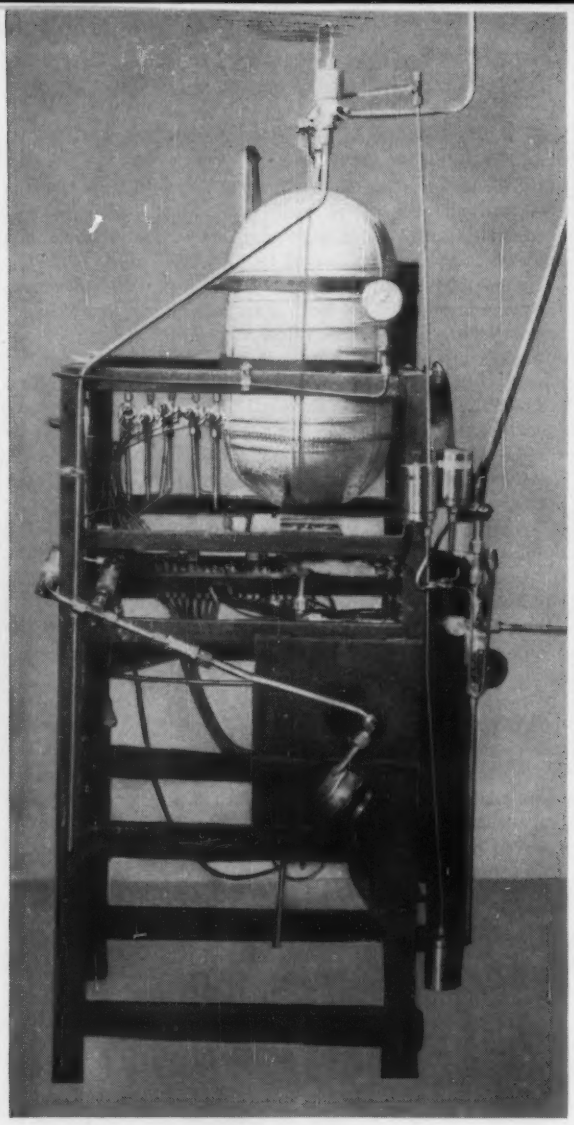
Electricians will check the operators' connections before the machines are started again.

To facilitate this procedure, the company is collecting special tools for each machine or group of similar machines. These will be kept separate in the tool crib, and handed out only in an emergency.

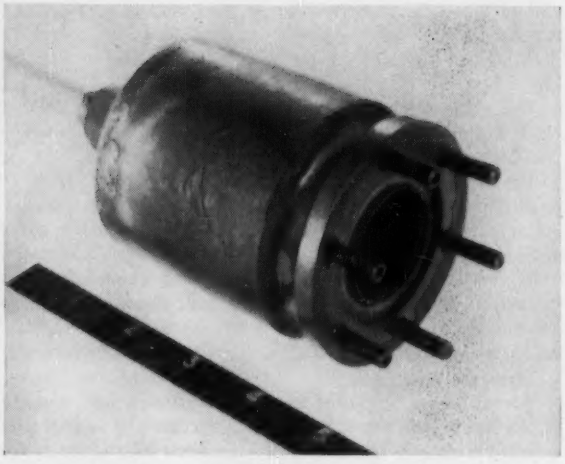
Another long-range program is relocating the control panels above all previous flood levels. This may save removing the controls if expected flood crest is low, will provide a margin of safety if there is no time to remove panels before flood hits.

Some precautionary measures that are just plain common sense were learned the hard way. For instance, when planer tables are stopped in the extended position, cranes can easily pick them up for salvage. Movable components on all machines are more likely to be out of danger if raised and left as high as possible. This may eliminate need for cleaning out silt; in any case it makes servicing the machine easier.

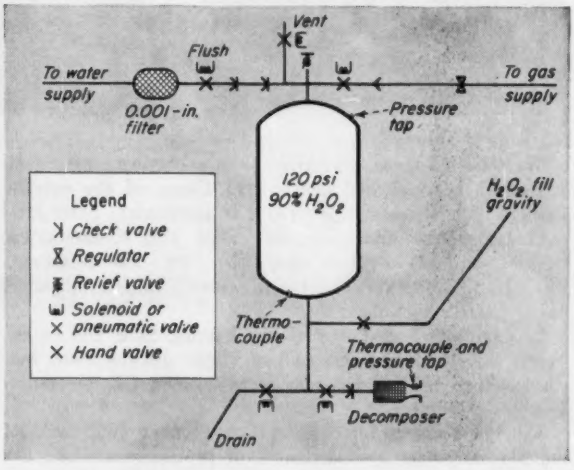
Besides this, we are improving communications with other plants up the river, and hope to have more advance warning of probable flood conditions before they hit.



1 Low-cost portable-power generator uses hydrogen peroxide to produce steam or heat, can drive one or more turbines



2 Steam generator for unit is actually a chamber in which a catalyzer aids in rapid decomposition of the H_2O_2 feed



3 Typical hookup of the portable-power generator described in this article. Automatic controls simplify operation

By E I FINGER, *Malta Test Station, General Electric Company*

Need portable power? Here's a low-cost high-capacity unit to generate steam

Hydrogen peroxide produces steam in this new unit. It can be used to drive one or more turbines, or to supply heat to process vessels in your plant

► No BIGGER than an office desk and weighing about 200 lb, the portable-power generator, Fig. 1, supplies almost instantaneously 1000 hp or more as a mixture of superheated steam and oxygen. Source of this energy is hydrogen peroxide (H_2O_2)—a liquid that resembles water in appearance and physical behavior. But there the similarity ends.

Chemically, H_2O_2 is radically different from water. When in the pure state it is relatively inert. But when some foreign matter is introduced, a violent chemical reaction may take place. By careful control a reaction of this type

can be harnessed to develop useful power. This is just what the unit in Fig. 1 does. Let's see how it works.

Hookup. Fig. 3 shows a typical hookup of a H_2O_2 tank, piping, water filter and H_2O_2 decomposer. To operate it, the desired amount of H_2O_2 is loaded into the tank through the gravity fill line. Other filling methods may be used, too.

Once the tank contains the correct weight of H_2O_2—say, 120 lb—the vents and filling connections are closed and the tank pressurized with nitrogen or air. In a portable unit like that shown, cylinders of air or nitrogen are used to supply the pressurizing gas. This gas must be clean because contamination of the H_2O_2 by compressor lube oil or rust from piping might cause undesirable reactions. Tank pressure may be adjusted by varying the setting of the gas-supply regulator to give the desired flow rate of H_2O_2, depending on the system pressure drop.

To start generation of steam the solenoid valve ahead of the decomposer, Fig. 2, is opened to allow H_2O_2 to flow into it. The decomposer is also called a steam generator because the steam is formed in it.

H_2O_2, entering the generator, contacts a catalyzer bed and heat is generated almost instantly—within 0.1 to 0.5 sec after contact. This heat, which is caused by partial decomposition of the H_2O_2, aids in complete decomposition. The catalyzer bed helps start, continue and accelerate the reaction, producing decomposition.

When H_2O_2 decomposes it forms water and oxygen—H_2O and O_2. Heat of the reaction causes the water to boil and it changes to steam, the boiling temperature depending on the percent by weight of H_2O_2 in the solution.

H_2O_2 by weight, %	*Decomposition temperature, F*
90	1364
85	1135
80	908
75	680
70	452

Several different materials act as catalyzers in the steam generator. One of the best and most common is pretreated silver screening.

Flush and drain valves, shown in Fig. 3, remain closed during steam-generator operation. They provide a quick means of diluting the H_2O_2. They are also used when it is necessary to drain the system. If system has been idle for some time it should be flushed with clean water before use. Also, it should be flushed out after each use. The outlet from the decomposer can be piped directly to the nozzles of a turbine, a heating coil, tank or other device. Steam leaving the decomposer may be expanded, as in a turbine, or it may be used for heating, as in a coil or tank of some type.

Equipment. Besides the equipment shown in Fig. 1, the only other facilities needed are a few cylinders of nitrogen or air, mechanically filtered tap water, electrical supply for valve operation and two recording thermocouples and pressure gages.

Exclusive of instruments, a system like that in Fig. 3 costs about $3000. It operates 60 sec at full power, proportionately longer at reduced output. Increasing the H_2O_2 tank size would give a longer operating time. The steam generators, Fig. 2, have operated continuously for several minutes at low power output, but for only one-minute cycles at full power. It is believed, however, that they will be satisfactory for operating cycles of several minutes' duration. Some have been used for as many as 40 one-minute cycles.

Use. These portable H_2O_2 systems have been in regular use for over two years. They drive a turbine wheel geared to a pair of centrifugal pumps. The wheel operates at 20,000 to 35,000 rpm, with the pumps absorbing 400 to 500 hp.

Two other recent jobs have impressed operators with the versatility of these systems. They first used the device to make an overspeed test of a new type of turbine wheel. We found that merely by reducing the flow rate of H_2O_2, stable, dependable operation of the system could be obtained at an output of only 30 hp. This made it possible to make the overspeed test with the available apparatus, after the pump and wheel were disconnected.

Second use was more novel. A process required raising the temperature of a light-walled aluminum tank 500 F in one minute. The tank had a diameter of 3 ft and was 5 ft long.

Heating by a gas ring was considered but was rejected because of the fire hazard and other reasons. Electrical heating was also studied but the local transformers could not supply the 300 kw or more required. Also, we found it would be difficult to furnish and properly mount enough strip heaters to do the required heating job.

So it was decided to use steam from a portable peroxide system to heat the tank. A circle of 1½-in.-diameter tubing was formed and mounted around one end of the tank with about ½ in. between it and the tank wall. Small holes were drilled in the ring so the steam would flow along the axis of the tank. A shield of 1/16-in. sheet steel was wrapped around both the tank and steam ring, leaving about 2 in. of air space between the tank and the shield. The shield was left open at both ends.

Results with this hookup were excellent. With full output of the H_2O_2 system, the tank reached 500 F in 30 seconds. In later runs the steam flow was reduced to meet the 60-second time requirement.

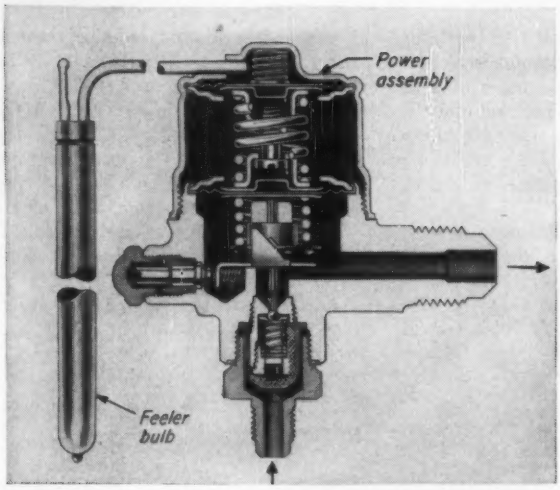
Other possible places for using this power system include wind tunnels, chemical plants and wherever large amounts of short-duration power are needed. Usually, to justify H_2O_2 the power needs must be so infrequent that the cost of conventional power plants cannot be justified. However, there may be instances where H_2O_2 is justified, even though conventional power might cost less.

In wind tunnels, steam turbines geared to blowers would probably be less expensive than electric motors. Also, turbine operation would not be limited to off-peak hours.

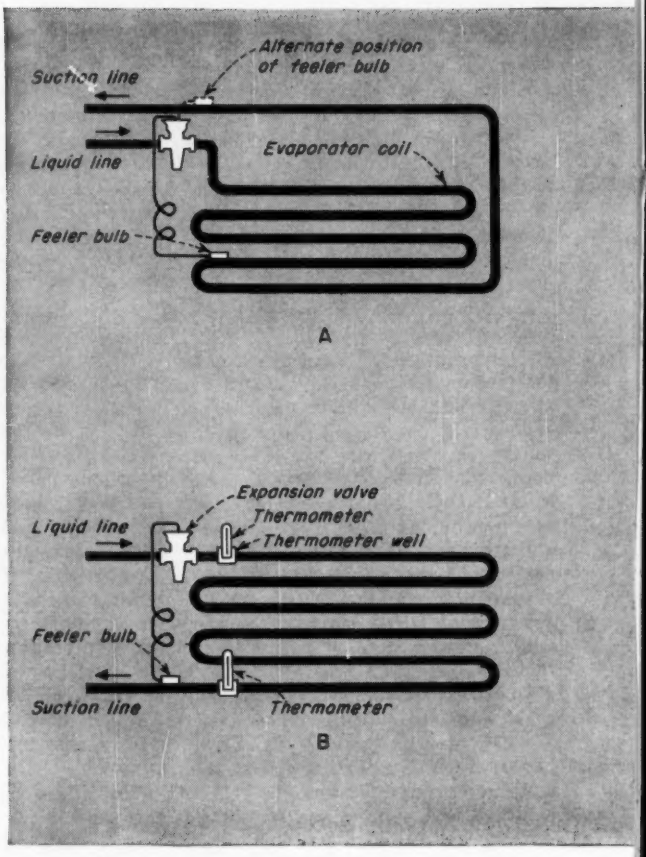
In the chemical industry there are a number of places where H_2O_2 portable power or heat would be applicable. The manufacture of ureas requires large amounts of rapidly applied heat initially, but relatively little heat (or even cooling) once the reaction is started. Its principal advantages would be almost instantaneous high Btu output with minimum space needs and low initial cost.

H_2O_2 may be purchased in any desired concentration. It readily decomposes in the steam generator at concentrations down to 70%. Weaker H_2O_2 will not react reliably. It is customary to buy a concentration of 90% and dilute as needed. The system described here uses a maximum of about 1.75 lb per sec of H_2O_2 when delivering 1000 hp. Output is easily controlled by varying the flow rate of the H_2O_2. This may be done by varying the feed pressure or by using restricting orifices in the discharge line.

As many as 19 decomposers have been used at once, fed by a single supply tank. Today, properties of H_2O_2 are so well known that there is little danger when informed personnel handle it. Specially treated stainless steel and aluminum are suitable for unit construction. Steam formed from H_2O_2 should be vented outside the plant; it is rich in oxygen and is a hazard.



THERMOSTATIC expansion valve automatically controls liquid flow into the evaporator. Feeler bulb actuates the valve



A: Clamp feeler bulb to horizontal suction line near evaporator outlet. Distance back to compressor decides location. **B:** Check valve adjustment from temp at its outlet and at bulb.

The expansion valve is the heart of a commercial refrigeration system. Here Charles Thielmann of Thermodyne Corp tells how the popular thermostatic valve works, and the pitfalls to watch for so you will . . .

Install and maintain your refrigerant

► THE THERMOSTATIC EXPANSION VALVE is the most popular liquid control for commercial refrigerant units. It regulates liquid refrigerant flow in exact proportion to evaporation rate.

Three forces govern this valve's operation: (1) pressure created in the power assembly by the remote "feeler bulb" (2) evaporator temperature (3) equivalent pressure of the superheat spring.

Feeler bulb and power assembly make up a closed system, charged with a liquid or gas. This is generally the same as the refrigerant. Valves are color coded.

Power assembly pressure depends on temperature at the feeler bulb. This pressure tends to open the valve. The force trying to close the valve depends on saturation temperature in the evaporator and the force of the spring. Difference in the two temperatures (the superheat) controls valve operation.

Factory superheat setting is usually 6 to 10 F. If operating superheat is unnecessarily high, evaporator capacity decreases.

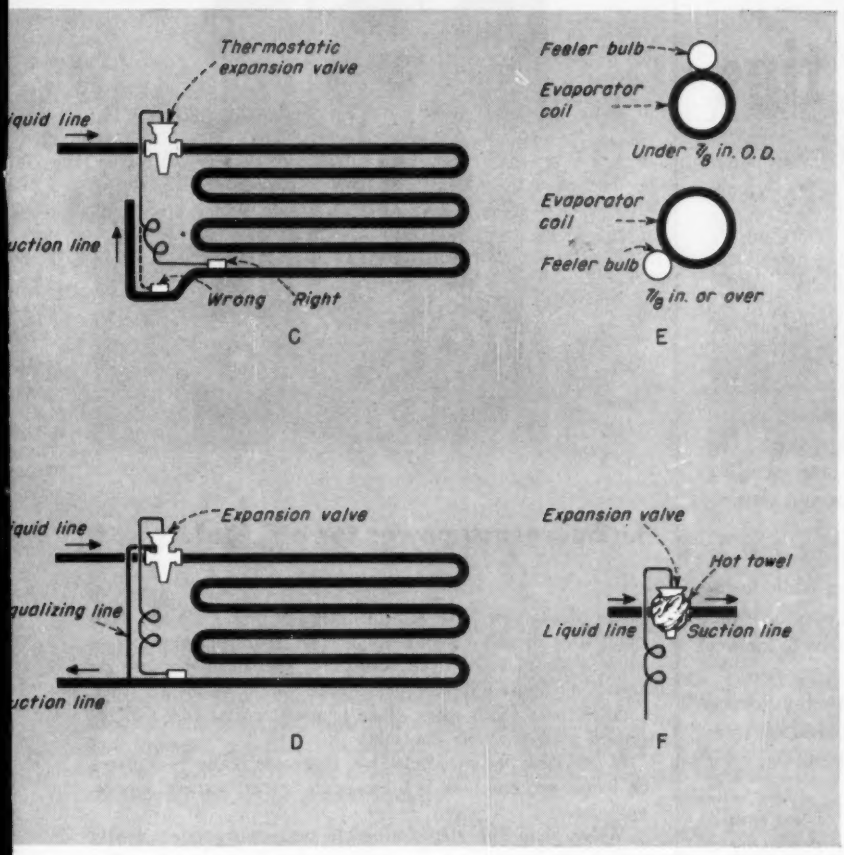
If pressure drop through the evaporator coil is more than 1½ psi, or if you are using a pressure-drop type of refrigerant distributor, valve should have an equalizer connection. This compensates for the drop in pressure, prevents "starving" the coil.

To select a thermostatic valve, determine the load in Btu or in tons of refrigeration. Next, determine the proper-size line connections, possible need for an external equalizer and the pressure differential across the valve. Select a valve with capacity equal to or slightly greater than load requirement. Connections should be as big as the liquid and evaporator lines.

Valve that is too small starves the coil; one that is too big hunts and causes surging.

Install the valve as close to evaporator as possible, in a spot where it is easily accessible for adjusting and servicing. Install a gas-charged valve where the body is warmer than the feeler bulb. This prevents charge from condensing in the power assembly. Liquid-charged valves can be installed regardless of temperature.

Clamp the feeler bulb to a horizontal suction line near the evaporator outlet. Use the strap provided. Don't let capil-



C: Never put the remote feeler bulb in a trap where refrigerant or oil can collect. **D:** Connect equalizing line on compressor side of feeler bulb. **E:** Position of bulb varies with different suction-line sizes. **F:** Use hot towels to thaw valve if frozen

expansion valves right

lary tube touch the suction line or evaporator coil. Exact bulb location depends on length of run back to the compressor. If feeler bulb is too close to the valve, you lose cooling effect; if it's too close to the compressor, you may get slugs of liquid refrigerant in the compressor.

On suction lines under 7/8 in. OD, put bulb on top of the line; for lines 7/8 in. and over, put bulb slightly below center (sketch *E*).

If possible, bulb should be in the refrigerated space so room temperature does not affect it. But don't place it so close to the wall that heat is conducted to it along the tubing.

To protect the bulb from the effect of an air stream, insulate it thoroughly with material that will not absorb moisture or admit air. This prevents ice formation around the bulb.

Never put the bulb near a vertical bend in the piping, or in a refrigerant trap. Any collection of liquid refrigerant at the point of the remote bulb location causes irregular valve operation with large fluctuations in pressure and superheat.

External equalizer line must be installed beyond the point of greatest pressure drop. As a general rule, connect to suction line at the evaporator outlet, on compressor side of the remote bulb (sketch *D*). Attach to top of a horizontal suction line to avoid oil clogging.

Equalizers must be free from effect of pressure changes in evaporators fed by other valves. Never join two or more equalizer lines together. Another point: do not cap or plug this connection. It prevents proper valve operation. If valve has an equalizer, use it.

Where pressure drop through the evaporator is extremely low, you can install the external-equalizer connection at the evaporator inlet, or preferably on a return bend midway through the evaporator. This last location provides smoother valve control. If there is a control valve in the suction line, connect equalizer on its evaporator side.

Valve adjustment must be right to prevent starving or flooding the coil. If you suspect valve is out of adjustment, check (1) suction and discharge pressures (2) superheat.

Check superheat with thermometers at valve outlet and feeler bulb. Use wells or tape the instruments on securely to be sure you get good contact (sketch *B*). Operate the system long enough to get steady-flow conditions at approximately the desired refrigerator temperature. Difference should be about 10 F, with temperature higher at the feeler bulb. If it is not, adjust the spring or bellows that counteracts feeler-bulb pressure.

Turn the adjusting screw one eighth or one quarter turn. Then watch the operation for an entire compressor cycle, checking carefully before regulating further. You get about two degrees change in superheat with a quarter turn.

The two main causes of valve malfunctions are (1) power assembly loses charge (2) moisture freezes in the valve.

Valve closes if it loses its charge. Replace the power assembly and feeler bulb in larger valves, or replace the entire valve on smaller installations.

Moisture may freeze the valve shut, restricting or stopping refrigerant flow. This starves the evaporator, causes low suction pressure. If valve freezes open, system floods, and suction pressure is high. Ice, caused by moisture in the system, can form whenever evaporator operates below freezing.

When compressor stops and expansion valve and system warm up, operation is OK until ice forms again. This may cause compressor to short-cycle.

To melt ice, wrap valve with towels soaked in hot water. Then install a new dryer in the line feeding the expansion valve. Operate the system above freezing for a few days. Moisture should then be trapped in dryer. If moisture persists, evacuate the refrigerant charge and oil, and dry the system with a vacuum and heat, or by blowing dry CO_2 through it.

Improper pressures or superheat may also indicate other troubles. See manufacturer's service manuals for details on correcting expansion-valve troubles.

ELECTRICITY

12 electrical tips that paid off

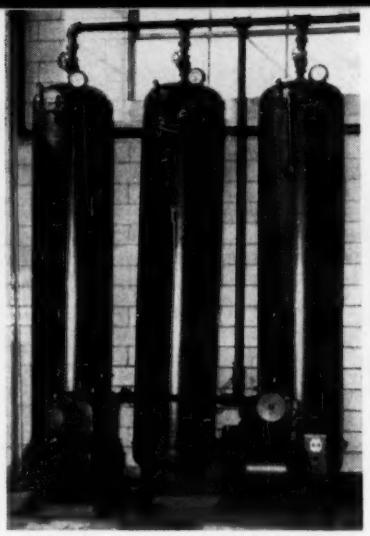
By L W FITZPATRICK, *Chief Engineer*
Dept of Corrections, Jefferson City, Mo.

There is a common thread running through the following practical tips from 12 electrical plants: call it a looking-ahead approach to keep out of trouble. Too many men in top plant-engineering spots are spending a major chunk of their time running around putting out "engineering fires."

Doing a top job now requires taking the time out each day to tend the small improvements, while keeping an eye peeled for major changes that may be shaping up. Skipping small things too often leads to a plant with a threadbare look.

Try carving out a little time each day for getting on top of the job. Plant engineers have found the time spent planning ways to improve plant operation, trim costs, save labor is time well spent.

You probably have met up with some of the simple ideas on these four pages: Might be you're using a few right now. But chances are it will pay you to adopt some that are new to you.

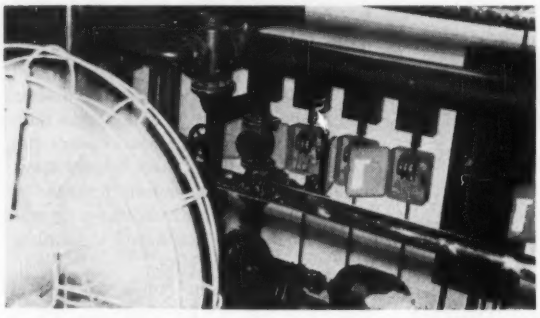


1 – Emergency power for air, too!

Many plants now have some emergency power set up. Our plant uses diesels rated 1440 hp that require 200-psi compressed air to start. And instead of just one large air receiver we figured it was smarter all round to install three smaller units. This move alone trimmed initial cost and required smaller safety controls.

If one tank becomes defective, there are really two spares on hand: any one tank is big enough to start a diesel engine our size.

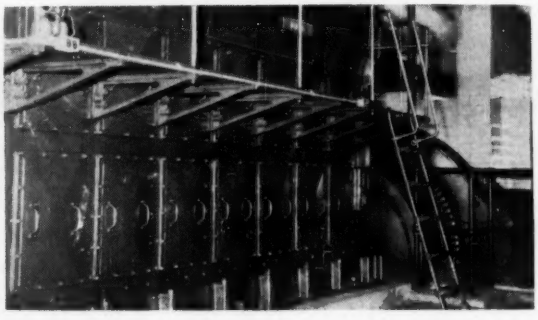
We've gone one step farther to make our system really foolproof. Two compressors are on hand for charging the receiver tanks—one is driven by an electric motor, the other is powered by a gasoline engine.



4 – A fan solved this control problem

During last summer's hot spell when outdoor temperatures in these parts reached 116 and the wall thermometer inside the plant read 123, several of our motor controls started to kick out. Rather than change the thermal relays in the starter equipment, we simply moved a portable fan into position, opened the covers on the starters causing trouble.

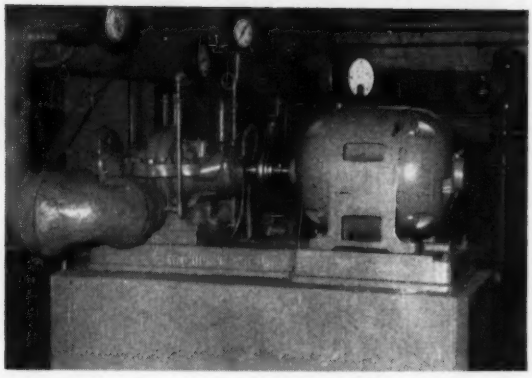
There are other ways a fan can be used to lick, at least temporarily, an overheating problem. Ever face an overly warm bearing at a time when the unit could not be taken off the line? Next time at least consider a portable fan . . . and maybe a cake of ice to boot!



5 – No dangling cords here

In the installation of a new diesel engine we skipped, on purpose, putting plug-in receptacles at floor level. Experience shows these low-level outlets call for heavy maintenance because of repeated floor washing. And those dangling cords are a real hazard to plant operators.

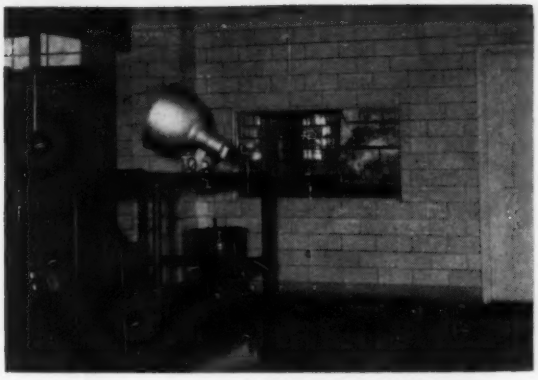
Instead, we carefully ran thin-wall conduit around the operating platform, spacing the receptacles as needed. Now short cords fill the bill and we don't have to wind and unwind long extensions. No. 12 wire and heavy-duty receptacles easily handle portable power tools and blowers with little loss in voltage between source and load.



2 – Install pumps for easy servicing

With the possible exception of the canned pump, all pumps doing a job in industry require maintenance. And our boiler-feed pump was installed with this in mind. What we did was set the 50,000-lb 125-psi pump about 25 in. off the ground. This may have cost more initially but it means we now have the pump at a convenient working height, which makes it that much simpler to adjust, maintain, repair, either the pump itself or the driving motor.

Another time-proven tip! We set all gages at a really readable range and so positioned that the operator can easily observe them from his desk. An ammeter shows pump loading plus checking on tightness when setting glands.

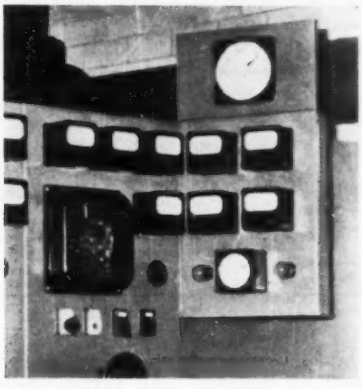


3 – Plant window helps chief operator

Taking a page from today's plant designer's notebook, I figured that we'd be way ahead if we installed a glass panel in the solid wall separating plant office from the operating floor. We did just that and now are in closer contact with what's going on day to day.

Replacing a solid wall with glass let us see all right, but we still were out of tune with many of the sounds. We licked that by simply loosening the seal around the hot-air duct. thus permitting plant noises to filter into the office. This gives a sound-check on the status of running equipment.

Added thought: New type "crystal" glass costs considerably less than plate glass, provides better visibility.

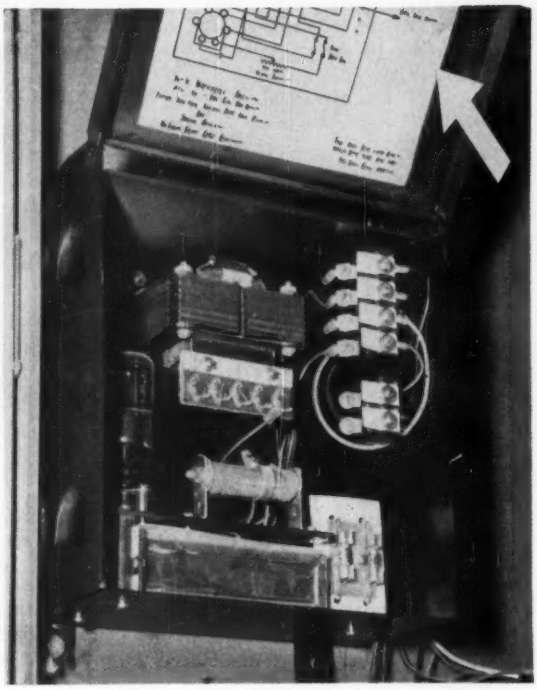


6 – King-size voltmeter for better visibility

New plant-control panels I've seen are generally following the trend toward smaller, compact instruments. We took the opposite approach to provide the best visibility for operators when they leave the main switchboard.

Matching panel was made up, photos above, then fitted with an 8-in. GE type AB-16 meter connected through instrument transformer to the main 2.4-kv bus. Easily visible, even at 35 ft, the meter we selected has a 3½-in. spread between major voltage divisions. We find the king-size voltmeters have it all over their smaller brothers when it comes to fine generator-voltage adjustment. Test plugs and a double-throw switch permit rapid testing using a variable-voltage transformer and standard voltmeter. Meter enclosure was adapted from a loud-speaker cabinet.

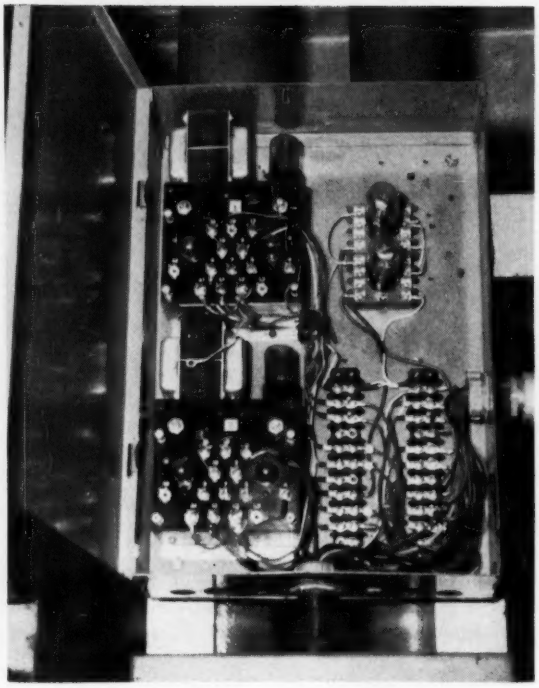
Turn page



7 – Speed maintenance with schematics

With a production line held up it is little comfort to know that somewhere in your files is a complete blueprint of the electrical hookup to help your men shoot trouble. Smart approach is to make up simple schematics before trouble hits. We speeded our electrical maintenance and trimmed equipment downtime by pasting modified circuit schematics in covers of all equipment cabinets. That way the circuit details are readily available, saving the search for dog-eared drawings supplied at time of original installation.

With all components identified and convenient voltage and resistance test-points labeled, a quick test with an ohmmeter and voltmeter generally pins down point of trouble. Today most manufacturers supply schematics on equipment lids on request. If not, make up your own, but by all means keep them simple so electricians will use them.



8 – Consolidate controls in one spot

Large transformer cabinets can be readily adapted to house motor starters, relays associated with limit switches, other elements used in electronically controlled apparatus. All you need do is remove the starters and controls from their factory enclosures and mount inside the larger cabinet. This immediately eliminates the hodgepodge of different-size cabinets, short nipples and fittings, plus saving on installation time.

Another angle: Where standby equipment is used a motor can quickly be bridged to another starter without removing numerous covers from enclosures and rewiring. With all controls in one cabinet, considerable time is saved during routine maintenance or trouble checks.

While you're at it, install a small exhaust fan with an air filter to permit closer spacing of controls.

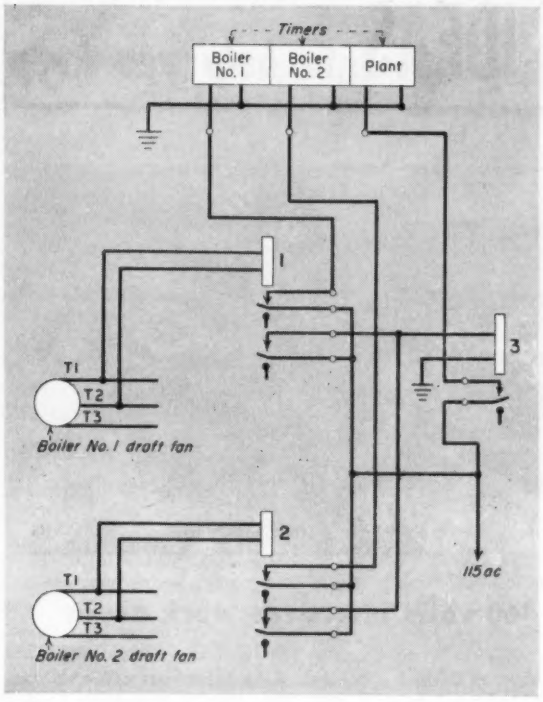
---

10 – Practical ways to get long life, better use from electrical controls

Where electronic controls can be operated at either 120 or 240 volts, we find it best to choose the higher voltage. There are several well-known reasons for this. Higher voltage permits use of smaller wire, a fact that has allowed us to pull more conductors into an existing conduit. And reduced voltage drop when operating at the higher potential trims voltage drop to the unit, often spelling the difference between top performance and sluggish operation.

Solenoid valve installations can often be simplified by slipping a single-pole switch into the circuit so valve remains open while servicing control mechanism. How is the installation simplified? Simply by eliminating need for a bypass valve. We did it and now it works swell.

Another tip on electric valves: Valves are available with a built-in safety feature permitting manual operation should current fail. Also, consider a compact test assembly for identical electronic controls. It's based on voltage and milliampere data supplied by manufacturer, incorporated into plug-in tester.



9 – Time clocks act as plant watchdogs

Regular 115-v timers are doing a top job in helping keep us on a continuous boiler-maintenance schedule. The three clocks connect to boilers as sketched, keeping a record of every minute the boilers are on the line. Third timer tells us the number of hours plant operates. When this figure is checked annually against flowmeters, we get the gross amount of steam produced yearly as an hourly average.

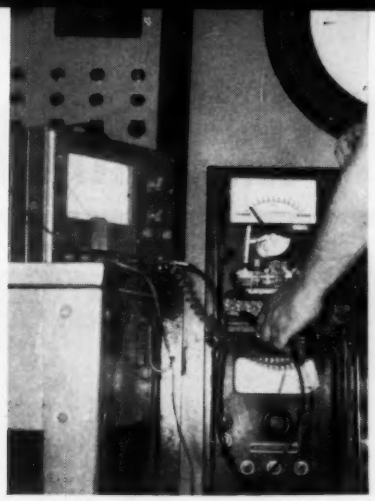
Percentage-wise we can determine which boiler carries most of the load and the exact hours of operation. Setup permits us to anticipate maintenance for every 1000 hr of operation. Typical: fan-belt and burner-tip work.

The three timers offer definite proof to management on the number of hours downtime for the plant. Also, the additional hours beyond the regular work hours the plant operated to produce steam for the manufacturing departments.

11 – Adhesive tape doubles as marker

Often the available pressure-sensitive marking tapes eventually curl at edges. We've found ordinary white surgical adhesive tape well suited for identifying relays, wires, terminals. A mechanical lettering set or typewriter transforms the tape into a legible marker, made permanent with a covering strip of transparent cellophane tape. It's clean to use and easy to apply.

New wetproof adhesive tape sticks to anything, including cold, damp, hot and painted surfaces; try it for marking jobs.



12 – Get the most from multitesters

Your electrical men should be leaning more and more on the tricks used by the radio-TV technician for shooting trouble on electronic equipment. Example: Use of a volt-ohm-milliammeter in place of the old test lamps. Often a few circuit checks with an ohmmeter get a man right to the source of trouble in a complex circuit.

When circuit trouble pops up it generally can be traced to one of four causes: *Accidental grounds* actually short-circuiting the insulated portion of circuit to ground; *short-circuits* as accidental contact between conductors normally separated; *open circuits* are discontinuous circuits while *high-resistance circuits* give symptoms akin to open circuits yet permit a small current to flow.

Ohmmeter portion of the volt-ohm-milliammeter gives a direct reading in ohms between any two test points. It's simply a dc instrument in series with a dry cell and a fixed resistor. Often a high-reading ohmmeter can pinch-hit for a megohmmeter for a rough check on insulation resistance. Most plant engineers hold to one megohm as minimum insulation resistance on their 480-v circuits. Never use an ohmmeter on a live circuit.

Where to use an ohmmeter? Any time you want to check circuit continuity or actual resistance between two points. Example: checking motor starter's hold-in coils, especially when changing the starter from one voltage to another. When a field coil for a dc motor is rewound, an ohmmeter check tells what resistance the field rheostat should have. If field measures 350 ohms in a 230-v motor, Ohm's law gives you the current flow as 0.65 amp. Use a field rheostat about 1½ times the field resistance. Here, a 600-ohm rheostat rated at 0.7 amp will do the trick.

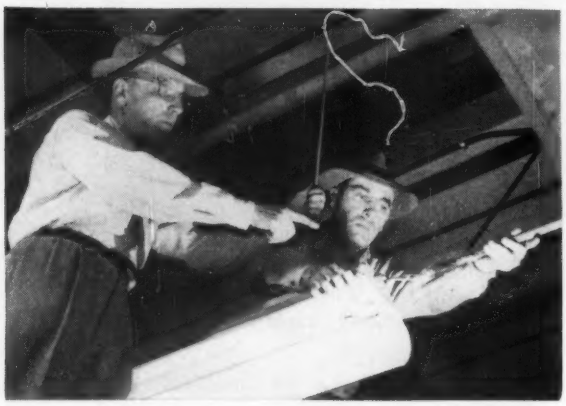
Other uses include checking grids on the secondary side of slip-ring motors, dc starting-equipment grids, identifying untagged leads from multispeed motor terminals. For accuracy, select a range on ohmmeter so needle falls about halfway up the scale.

Milliammeter section of instrument comes in handy with electronic controls. But keep within the scale limit. Remember for these portable instruments, accuracy is had when lying flat or standing vertical.

Steer clear of connecting milliammeter leads across a fuse in a live circuit pulling current. If the fuse element should blow or become loose, the instrument will be burned out. Best bet is to remove the fuse from circuit and measure its resistance.

Check ohmmeter accuracy by occasionally comparing with a resistor accurate to 1%; close enough for your needs.

Latest PRACTICAL IDEAS *to help you keep*



Our modern fluorescent lighting on 460 volts improves work areas

Gone is the day of the 115-v circuit for large areas that require maximum candle-power illumination. Trend is to increase voltage, not copper size. Copper is mighty expensive today. Photograph shows ample lighting saturation with the new voltage. To have added more illumination would have called for rewiring with No. 12 wire throughout our plant. With 460-v service we installed only a No. 14 run in *Electrunite* thinwall conduit: no threading, easily bent.

Total of 4200-sq-ft floor space required upping candle power to desired 60 lumens per watt. Our estimates were about $0.5379 per sq ft.

Run of thin-wall permitted using ballast channel for the wire, with No. 12 to taps and No. 14 for branches. Original fluorescent supports of *Unistrut* stock required but little extra reinforcing to hold added fixture weight. We were careful to maintain load balance across the circuit's three legs. Step-down control transformer allowed us to use inexpensive 115-toggle switch for control. Each fixture has a sized-O contacter, with plug-in interlock needed for safety of maintenance personnel.

Original lumen output was 20 lumens per watt while the new installation rates 60 lumens per watt. Even with a slight coating of vapor and fuzz the light meter indicates we still have slightly over 72 foot-candles. And we cut installation time to bone so cost per square foot of floor space was only $0.482. Do we like it? Ask the girls.

P C ZIEMKE *Oak Ridge, Tenn.*

Should service engineers use trailers?

Service engineers spending most of their time on the road often ask us if they should buy a house trailer. Here's information from the service department of the Riley Stoker Corp.

Costs. Using these vehicles as a truck skyrockets maintenance. One engineer had to spend $1750 extra on repairs after a short time. Living costs for man with family go down over a 3-year period. Let's assume your trailer cost $4000. Expenses first year exclusive of food: $2685. Second year, exclusive of food: $2100. So a trailer probably begins to pay off the third year. But maintenance on towing vehicle must be kept low. Only advantage of having a trailer is for long jobs. On short jobs you decrease your mobility.

Depreciation. New truck and trailer depreciates 30% first year, or about $2000. And depreciation and costs are canceled out if you drive 18,000 miles per year at rate of 7c a mile (for automobile). Pulling a trailer represents 4c per mile that you go into the red. Savings on expenses can't compensate for first or second year depreciation.

State laws. Over-all length of trailer and pulling vehicle are 45 to 55 ft. Most cars are 17 ft, leaving 28-ft limit for trailer. Most house trailers exceed this limit.

Sunday and holiday travel is limited in some states on over-length combinations. For literature, send for State Motor Vehicle Laws Affecting Trailer Coaches, to National Highway User Conference, 952 National Press Bldg, Washington, D. C.

Here's water-usage rates for drinking fountains

Cooler location, plus peak demands and duration of an average drink at a water cooler is given in a paper by research engineers of U.S. Bureau of Standards, Washington, D. C.

Peak-draw needs are usually met by a storage tank, in cooler. Tank size is found by peak-draw needs. Although

STEVE ELONKA, *Associate Editor*

storage tank permits use of a smaller condensing unit, some makers build instantaneous-type coolers.

Use of peak-draw need is often questioned because drinking-water coolers can be made simpler, smaller and cheaper if tanks aren't used. To provide information on water-demand rates for electrically operated drinking-water coolers, 16 stations were studied. Coolers were in office buildings, mess halls, classrooms, military barracks, a garage and a bus terminal. Data were taken at each station by photos.

Study shows drinking habits differ according to occupation, freedom to use coolers at all times, location of coolers, and presence of several drinking fountains in same area. Here are findings: An hourly water usage of 0.05 to 0.075 gph per person can be expected in hot weather where there's access to cooler and people do fairly light work. Manual laborers use more water.

But average hourly water use did not reach nominal 10-gph capacity at any of the stations. Hourly rate didn't even exceed 5 gph.

In 15 minutes peak use of water exceeded 1½ times the hourly rate required of a 10-gph cooler at six of the 16 stations. At most of these stations, people's occupation prevented them drinking for periods of time. Then as a group they received a rest period.

Ratio of number of drinks taken in 15 minutes to number of people served by cooler approached 100% for classrooms studied. On an hourly basis, this ratio ranged from 112 to 163% for one half of the group.

Average drink from bubbler-type cooler was in seconds. Average use was 0.055 gal per drink, or one-half pint.

Rate of water usage could not be correlated with outdoor temperature on an hourly basis. But on days when maximum outdoor temperature was 90 F or higher, peak water usage occurred more than twice as often as on cooler days.

Ratio of peak flow rate for 15 min to the average hourly rate of water withdrawal was greater than 150% at 13 of the 16 stations. Ratio was above 200% for 17 stations and reached a maximum of 308%. These values indicate that a ratio of 150% between peak-draw rate and hourly as required by current specifications isn't enough for some applications. Also, greater storage capacity may be needed. This information may help you size plant coolers.

P C ZIEMKE *Oak Ridge, Tenn.*

What would you have done?

Our diesels gave good service for over 30 years. We maintained them on schedule, cleaning pistons of our 2-stroke cycle engine every six months. Our 4-stroke cycle unit was cleaned yearly. We seldom found a stuck ring.

Then our fuel dealer recommended a cheaper fuel oil. After using the new fuel two months, a piston of our 2-stroke cycle engine seized, cracking the piston and liner. We pulled the other pistons and found all the rings stuck. Carbon deposit was very hard. First, we soaked in carbon solvent. Then, we followed with 24 hours of boiling in 5% caustic soda and water.

Our operating engineer had neither altered the fuel-pump rack nor overloaded the cylinder. And trouble wasn't from lube oil or water failure.

Fuel dealer said trouble didn't come from his fuel, but from our lube oil, which we bought from another firm. According to him it wasn't well-matched to his fuel. But lube dealer said trouble came from fuel oil. My boss went along with fuel-oil dealer so I had to do something.

Out here on the Islands we don't have the experts to consult that you people have in the States. I filled one bottle with new fuel, and another with the old. Then I placed a copper rod in each bottle. After 20 days I noticed the copper rod in the new fuel was totally covered with a substance that indicated a sulfur content.

With this evidence, I was able to convince our management that the new fuel caused the trouble. We went back to old fuel. What would *you* have done?

A CAMACHO *Cebu, P. I.*

You can make this handy oil-can holder

Take a tin can slightly larger than diameter of oil can. Cut off one end about 5/8 in. from bottom, sketch. Make a wall bracket and rivet the bottom of tin can to bracket. Round off cut edges so no one gets hurt from sharp edges.

W A ARY *Seattle, Wash.*

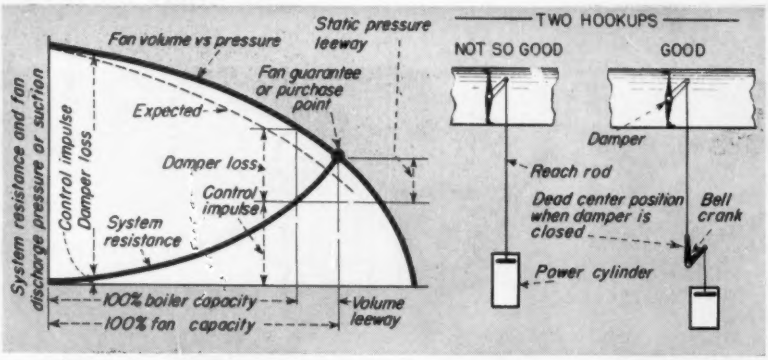
Let us send you $$ for your wife's new hat

DID YOU EVER get a check from POWER? It's easy. Just send me your latest practical improvements. Add sketches, photos, or both. You'll receive a check for each idea I accept. Some readers get these checks every month. Don't let your wife down. Send me your ideas today.—*Steve Elonka.*

(*Turn page for more Ideas*)

More PRACTICAL IDEAS

Begins on page 130



Bell crank solves f-d, i-d control problems

Fan volume vs pressure curve shows characteristics of normal fans. Solid curve indicates test-block performance as tested by fan manufacturer according to fan-testing code. Dotted curve shows expected performance in field, when fan inlet or outlet conditions are not ideal for top fan efficiency.

Fan guarantee or purchase point is location on fan volume vs pressure curve where system resistance crosses. This is ultimate capacity and static pressure combination that can be had if draft-loss predictions are realized—also, if fan performance equals test-block conditions.

System-resistance curve is a square-law shape for most applications. It should be plotted from boiler-performance data sheet against fan-performance curves of fan manufacturer.

Square-law shape of system-resistance curve, above, simply means that if we double volume we have four times amount of static pressure to overcome. For most practical purposes, that square-law relationship exists. But if there are large changes in temperature at various loadings, or, for induced-draft fans large changes in excess air values, then system-resistance curve departs from square-law rule by amount of such change.

Now we come to damper-control problem. Inspection of performance diagram shows that at 100% boiler capacity we have to damper fan to hold its capacity down to required point. We have a control impulse of perhaps several inches available to automatic control. So it should respond properly.

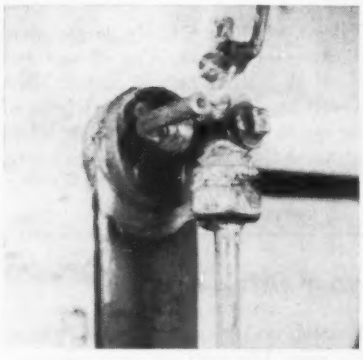
When we get down to low ratings on boiler, we have to damper much more. Control impulse will fall off to almost zero. Thus we'll need a large dampering effect while having a small control impulse.

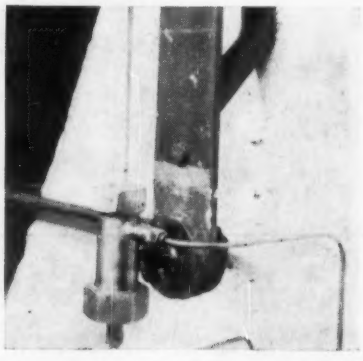
Remember, there must be a minimum impulse to which the automatic control responds. Also, there must be a minimum amount of piston travel that can be had from such impulse. Then it follows that damper linkage should be arranged to best meet the characteristics mentioned above. You can do this by arranging linkage so damper starts off of closed position with low angular velocity. So, when damper loss is heavy, as at low loads on boiler, a very slight movement of closed damper will make a large change in controlled flow of air or gases. You want damper movement to be as slow as possible near the closed damper position.

On the other hand, when damper is near wide-open position, there's little damper loss. But we want damper to move with a high angular velocity because a large damper movement is needed to get corresponding flow control.

Damper linkage, center sketch, is common. Linkage diagram with bell crank comes close to meeting all requirements. Use this when you have trouble with low-load regulation. With bell crank, closed and open positions of controlled damper must correspond to reaching end of piston stroke in power cylinder as indicated in sketch.

L V Andrews *Worcester, Mass.*





We stopped bubbling in our vacuum gage glasses

In Europe, we generally use water-gage arms with cocks on our condensers and receivers when under a high vacuum, second photo. When gage glass is cleaned, we find that the cocks leak air because they have been disturbed. Then the water bubbles and shows wrong water level, making cocks unreliable.

Operators often try to stop bubbling by coating, with a heavy paste, all possible places that air might leak through, first photo. This is a messy job and doesn't always work.

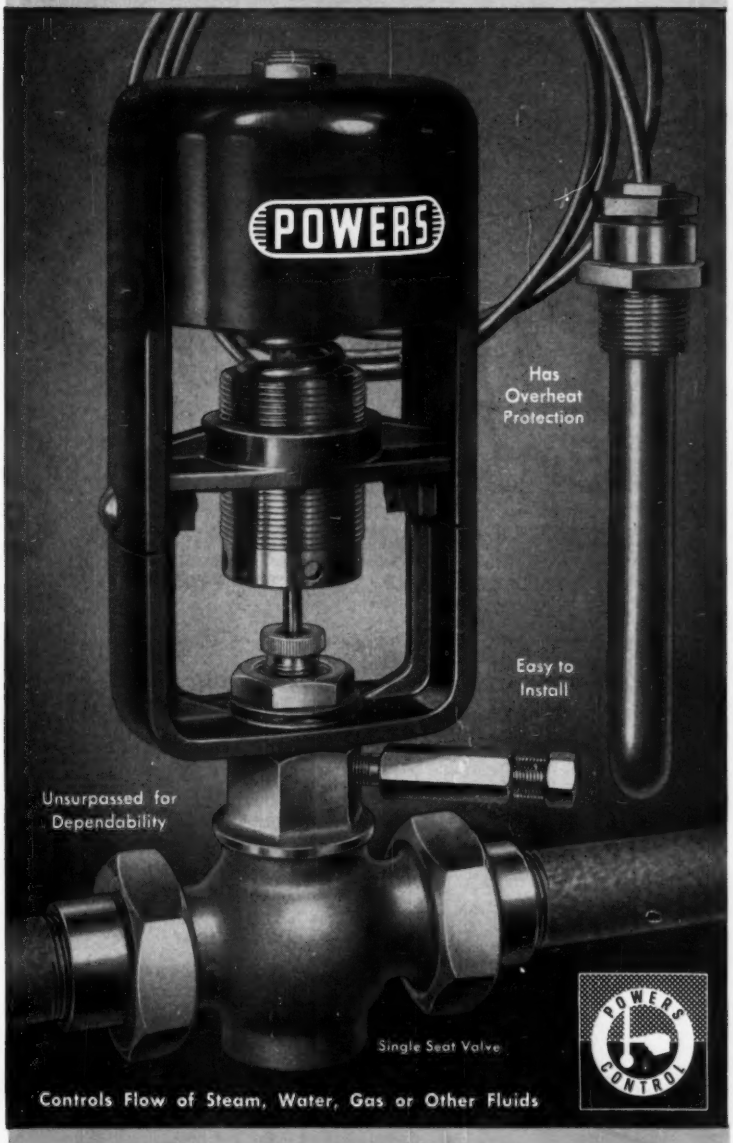
To solve our problem, we did away with the cocks, second photo. We ran a copper tube to supply hydraulic pressure under the rubber ring of the glass. Condensate pump keeps condensate pressure here so air cannot leak in. A second line supplies water pressure under the plug, which is unscrewed when glass is cleaned. A third water seal goes to the stuffing box of a stop valve, not shown in photo. Now our water gages on vacuum system are always clean and water doesn't bubble as it did before.

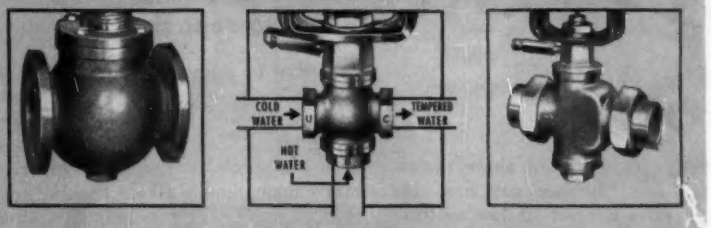
P A Roubinet *Comines, France*

(*Turn page for more Ideas*)

POWERS No. 11 Self-Operating TEMPERATURE REGULATOR

Automatically holds temperature constant at the right point. Prevents losses caused by wasteful OVER-heating.



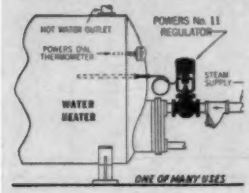


Various Valve Bodies and Inner Valves are available. Single and Double Seat Valves thru 2" have rugged bronze bodies with bronze union connections for quick, easy installation. Bulletin 329 gives information about all types.

(c88)

Why It Gives BETTER CONTROL and Saves More Money

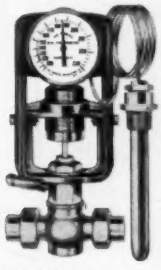
Often repays its cost 3 to 6 times a year when used on:



Water Heaters — Industrial Processes — Heat Exchangers — Fuel and Crude Oil Heaters — Air Compressors Diesel Engines

ONLY POWERS No. 11 REGULATOR Offers ALL These Advantages

- **Simple, sturdy construction.** Materials used are corrosion resistant.
- **Powers bellows has 50% more power** than used in the majority of regulators. The heart of a self operating regulator is its bellows. Powers with its 50% greater effective area gives better control and its durable 2 ply bellows outlasts ordinary single ply bellows.
- **Valve stem lubricator** with silicone grease aids easy movement of highly polished stainless steel valve stem and reduces drying out of packing.
- **BETTER CONTROL** results from Powers powerful bellows and minimum of valve stem friction.
- **60°F. temperature ranges** available with accuracy of ±1°F. on some processes and 2 to 3°F. on others.
- **Rugged bronze valve bodies with bronze union connections,** for single and double seat valves thru 2", reduce installation time and labor. Larger sizes have flanged iron body valves.
- **Powers Nationwide Service and 24 Hour Delivery** in the U.S.A. are important time and money saving advantages.



- **Indicating Regulator** with easy to read 4" dial thermometer helps adjust the regulator and check temperature at the bulb. Various dials and ranges are available.

Right type and size of valve is important for good control. May we help you make the right selection? Benefit from POWERS more than 60 years experience with self-operating regulators.

Call our nearest office or write us direct for Bulletin 329.

THE POWERS REGULATOR CO.

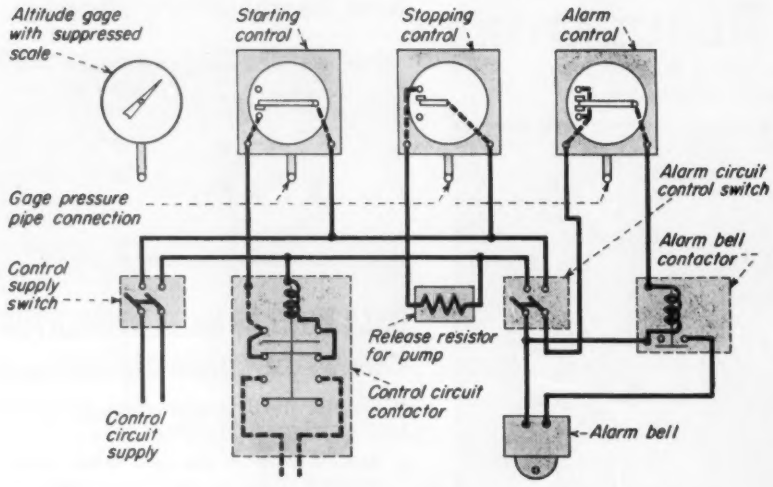
Skokie, Ill. | Offices in Chief Cities in U.S.A.
Canada and Mexico | See your phone book

Automatic Temperature and Humidity Control

Established 1891

More PRACTICAL IDEAS

Begins on page 130



Easy way to control water level at a distance

Controlling water level within close limits is no problem if all features are indoors within close range, or, if through use of float switches to operate electrical control-contact, device can be easily adjusted to the range required.

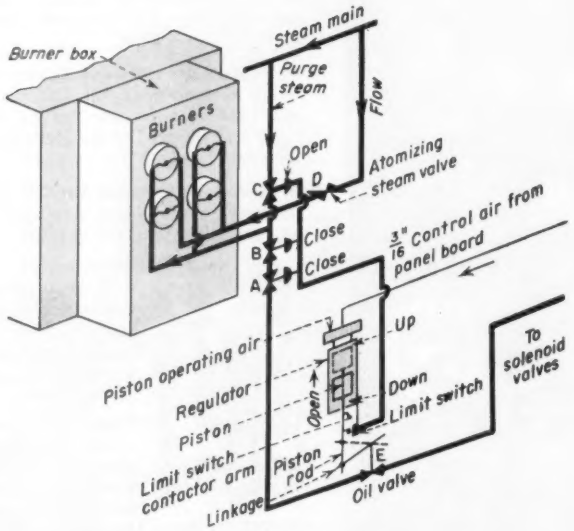
This job was put in to control level of a shallow tank, 600 ft from pump. It was mounted at a higher level, where range was to be controlled to a 10-ft variation. That represents a pressure variation of less than 5 psi. That's a very small variation on a gage with a 150-psi dial. Besides, need for keeping installation costs low required a new approach to control problem.

Consulting with gage manufacturers, we found that by using gages with suppressed scales, low-pressure variation would cover a greater scale range. Then we could use contacts attached to dial mechanism. Besides, using separate gages for high and low level required only one set of contacts per gage. We used one gage to show tank pressure, another to sound an alarm when either level varied beyond required limits.

Pumping equipment was centrifugal type. Gages were connected to discharge pipe between discharge check valve and stop valve with a pipe. Area was large enough to avoid gage mechanism jumping.

My diagram shows general features of system. We put three installations of this type into service with good results. Main advantage is location of simple equipment near pump-control plant. No equipment is at a distance or hard to get to. Also, installation cost is low.

C O VON DANNENBERG *Brooklyn*



Here's your 'trick' of the month

OUR COMBUSTION CONTROL system handles blast furnace gas (primary fuel) and fuel oil (secondary fuel) either together or separately. But oil tip carbonized, causing plugging up and fouling. Flame failure became a problem. To solve this problem, we changed fuel oil system, as shown in above sketch.

When blast furnace gas fires 100 percent, valve E (fuel oil flow control) is in close position. Regulator piston in bottom position makes contact by lever with limit switch. Limit switch energizes solenoid valves A & B (close position), and solenoid valve C (open position). Valve C admits 1000-lb steam per hr through oil burners. Valve D (steam atomizing) is the constant pressure differential type. In the "almost close position" (with 35 psi spring tension), it admits 800-lb of steam per hr through the steam passages. Having steam passing through both oil burner passages keeps oil burners clean and ready for oil firing.

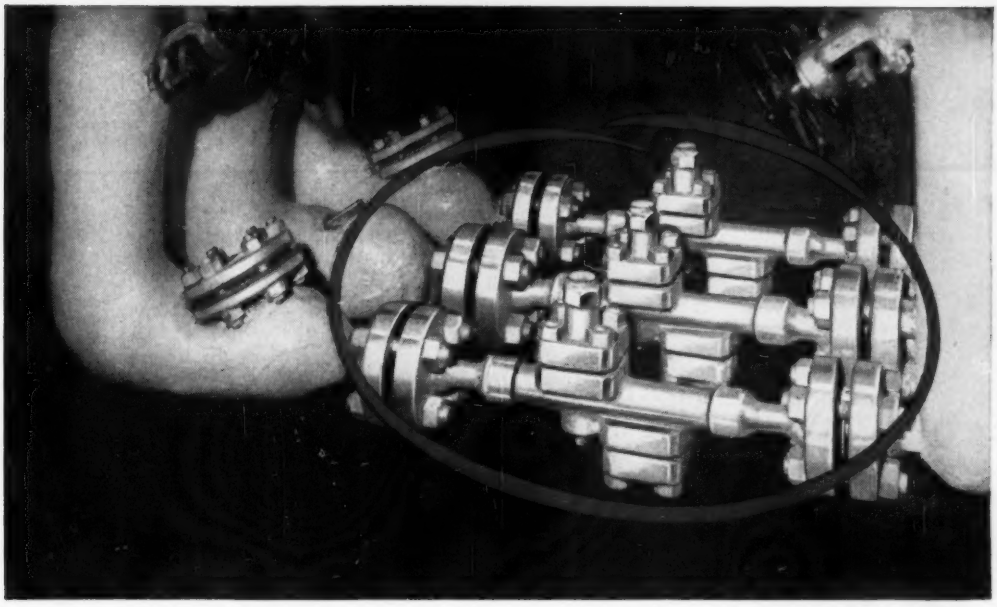
When blast furnace gas pressure drops to 12 in. of water gage, valve E opens, solenoid valves B and A open and solenoid valve C closes. Valve D opens to maintain a 35 lb. pressure differential greater than oil pressure.

D W ANTONACCI *Bolivar, Pa.*

When to repack

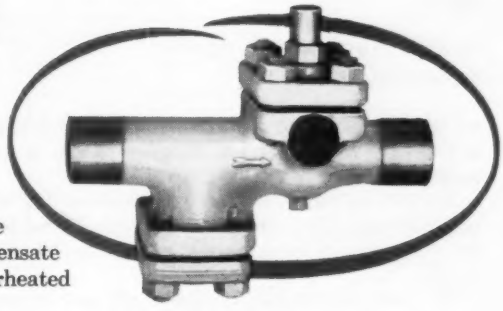
One way to know when to repack a stuffing box is to measure depth of new packing in box. Keep a note of this information. Then when packing has been compressed to two thirds of original volume, remove all old packing and repack. Reason is that when packing compresses about one third, all the original saturants or lubricants have been squeezed out and it may score the shaft.

M A STEVENS *Flushing, N. Y.*



Three Yarway Integral-Strainer Impulse Traps draining main steam lines in large mid-west power plant. Other Yarway traps drain extraction lines in same plant. Yarway Integral-Strainer Impulse Traps are available with welding or flanged connections. Pressures 600, 1500 and 2500 psi.

HIGH STEAM PRESSURES AND TEMPERATURES CALL FOR YARWAY INTEGRAL-STRAINER STEAM TRAPS



YARWAY Integral-Strainer Impulse Steam Traps drain some of the hottest steam lines in the country—temperatures up to 1000° F and pressures as high as 2500 psi.

When system is being warmed up these traps have ample capacity, yet will handle relatively small amounts of condensate without losing prime . . . and in the presence of dry or superheated steam, the trap valve snaps shut.

Leading utilities and other high pressure steam plants appreciate the other YARWAY advantages, too, such as *small size, light weight, steel construction, easy maintenance.*

For complete description write for Bulletin T-1740.

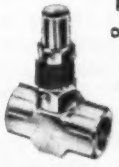
YARNALL-WARING COMPANY • 100 Mermaid Avenue, Philadelphia 18, Pa.

THERE'S A YARWAY IMPULSE STEAM TRAP FOR EVERY TRAPPING NEED

SERIES 60 and 120

For all *normal* trap requirements, pressures to 400 and 600 psi.

½" No. 20-A

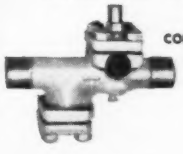


For *light loads* on tracer lines, steam mains, small presses, etc.

SERIES 40

For *heavy loads* requiring extra high capacity steam traps.

INTEGRAL-STRAINER HIGH PRESSURE TRAP

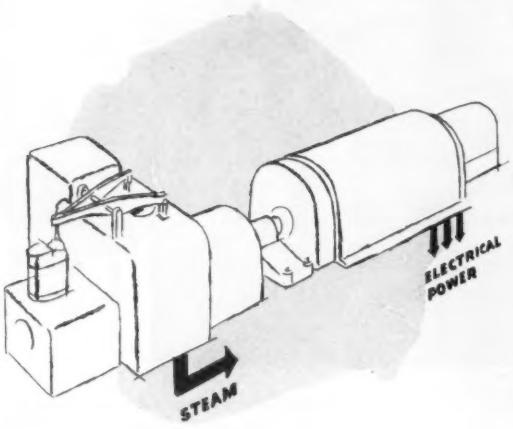


For *high pressures, high temperatures.* (Flanged or welding connections.)

YARWAY IMPULSE® STEAM TRAP

OVER 1,000,000 YARWAY IMPULSE STEAM TRAPS USED

Solving PLANT PROBLEMS... readers



The question

Is this byproduct power setup best for us?

We have a 100,000-lb-per-hr boiler, now operating at 190 psig, 520 F. Unit is designed to run at 475 psig, 720 F.

We plan to buy a backpressure turbine that will take 450-psig, 750-F throttle steam and exhaust into the plant high-pressure steam system at 190 psig, 500 F.

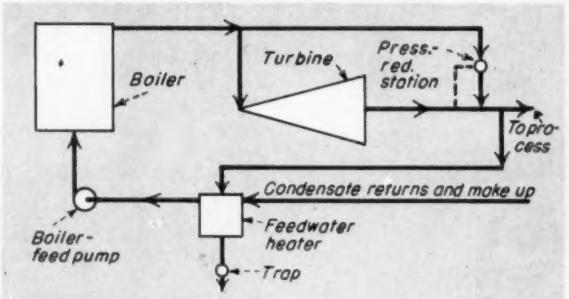
All steam generated by the boiler will pass through the turbine. Bypass arrangement consisting of a desuperheater and reducing valve will cut in automatically if steam demand exceeds that going through the turbine or if the turbine is out of service.

My figures show that about 2000 kw could be generated at full load and that full-load steam rate would be about 50 lb per kwhr. Steam rate at half load would be about 60 lb per kwhr.

Does our plan conform to sound engineering practice? Do readers know of succesful installations operating under these approximate conditions? What would be the approximate cost of such a unit?

Our steam load varies from 100,000 lb per hr during winter weeks to 18,000 lb per hr during summer weekends.—*LML, October Power*

The answer



NONCONDENSING TURBINE cycle generates low-cost power

Maybe, says Flanery, but . . .

Proposed plan for generating byproduct power, above, includes existing high-pressure boiler supplying steam to a noncondensing turbine that exhausts to the 190-psig process-steam system. Pressure-reducing station allows bypassing the turbine if steam demand calls for it—or if the turbine is out of service. Desuperheating station can be added if temperature limits of process are relatively low.

I would install an l-p feed heater on suction side of boiler-feed pump. And I'd consider putting in an h-p heater between feed pump and boiler. Boiler design dictates whether or not these heaters are needed. *LML* should study performance curve of feed temperature vs temperature leaving superheater to choose best feedwater temperature.

If process returns only small quantity of condensate, extensive treatment of makeup water may be necessary. And operation at 400 psig needs closer attention to feedwater quality than 190-psig system.

Basically, system proposed conforms to sound practice. It's one that's doing a top job for many industrial power plants. And straight noncondensing setup yields greatest investment return—if there's a fairly constant ratio of byproduct power to process steam. Graph, top of opposite page, shows steam consumption of such a turbine.

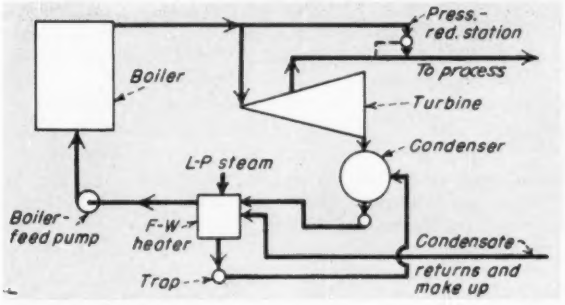
With 100,000-lb-per-hr steam load and 2000-kw byproduct power load this arrangement balances efficiently. But, during summer, steam load drops off to 18,000 lb per hr. Power load probably remains high. If other economical electrical power sources are available in summer there's no problem. But if the turbine must continue to produce 2000-kw, *LML* must exhaust large quantity of steam to the atmosphere.

Steam flow of 100,000 lb per hr minus 18,000 lb per hr means that 82,000 lb per hr is lost. At 50c per 1000 lb, cost is $41 per hr (assuming 80% boiler efficiency at 40c per million Btu). If this is the case, a condensing automatic-extraction turbine might be a practical move. Diagram, top of next page, shows how such a cycle is hooked up.

This alternate plan includes the existing h-p boiler supplying steam to a condensing-extraction turbine. 190-psig process steam is extracted from turbine. Bypass with pressure-reducing station is similar to first scheme. Steam, needed for byproduct power over and above process needs, expands through l-p section of turbine, exhausts to condenser. So *LML* uses steam energy from 400 psig to 3.0-in. Hg.

cure each other's headaches

HOWARD KALLEN, *Assistant Editor*



CONDENSING-EXTRACTION TURBINE cycle is flexible setup

. . . first work out alternate designs

When electrical power demand is more than can be generated by needed process steam, steam flow, compared to first plan, dips substantially. Reason: Steam rate for straight noncondensing plant was over 50 lb per kwhr. Alternate-plan steam rate is only a little over 11 lb per kwhr on a condensing basis.

Graph, bottom right, shows performance possible with the extraction turbine. For instance, with 2000-kw electrical and 100,000-lb-per-hr steam load, total steam to turbine is 107,000 lb per hr. Condenser flow is 7000 lb per hr.

With 2000-kw electrical and 18,000-lb-per-hr steam, flow to turbine is 38,000 lb per hr. So, by difference, condenser flow is 20,000 lb per hr.

Comparing the two plans, first loses 82,000-lb-per-hr h-p steam, while second loses only 20,000-lb-per-hr exhaust steam. This comparison is true only for a typical summer weekend —the only time an extreme condition exists. But for this period alone (again assuming 80% boiler efficiency at 40c per million Btu) the 20,000 lb per hr represents only $10 per hr lost. In 22 such days a year, the $31-per-hr difference piles up to $16,400.

Using Power's Data Sheet (Sept '55, p 103) assuming a 10% return, 15% depreciation rate and a 50% federal tax on net savings, we find that an additional $48,000 investment is justified to save $16,400 a year.

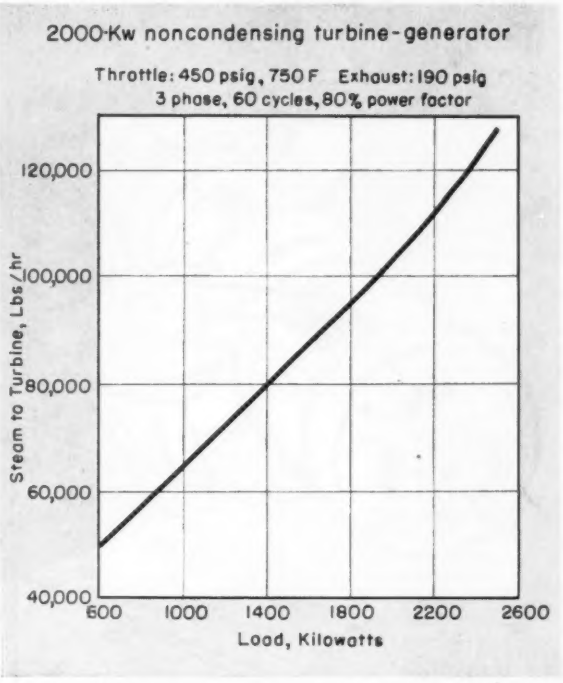
Other factors *LML* must consider in coming to a decision are: (1) Cost of feedwater lost in the original plan. (2) Cost of condenser circulating water and additional auxiliary power in the alternate plan.

Performance curve, bottom right, is for 2500 instead of 2000 kw to point up added capacity available from comparatively smaller steam flows. The curve is good for a 2000-kw unit also, if we set the correct limit on right-hand part of the curve.

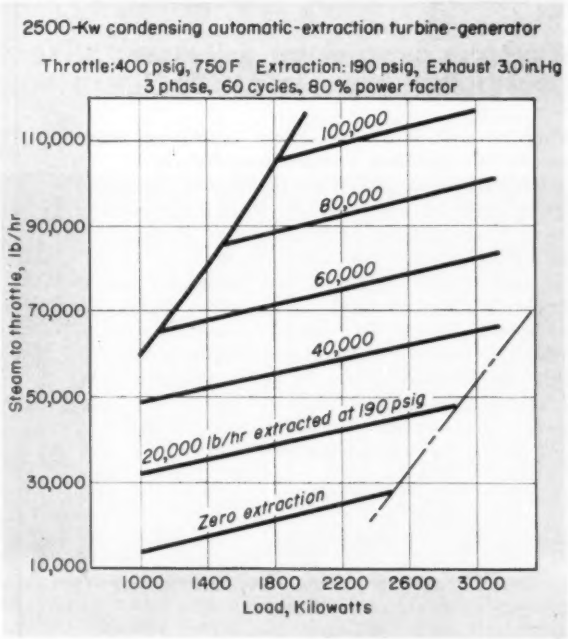
LML wants to operate the boiler at 475 psig, turbine at 450 psig. Break point in standards is at 400 psig. If 450-psig throttle pressure is specified, *LML* will probably need 600-lb turbine construction. So he may be better off operating the boiler at 425 psig, with turbine at 400 psig.

B K FLANERY *St. Louis, Mo.*

EDITOR'S NOTE: *Good letters were received from other readers, backing up Flanery's thoughts. Lack of space doesn't permit printing them here.*



STEAM-CONSUMPTION curve for *LML's* backpressure turbine

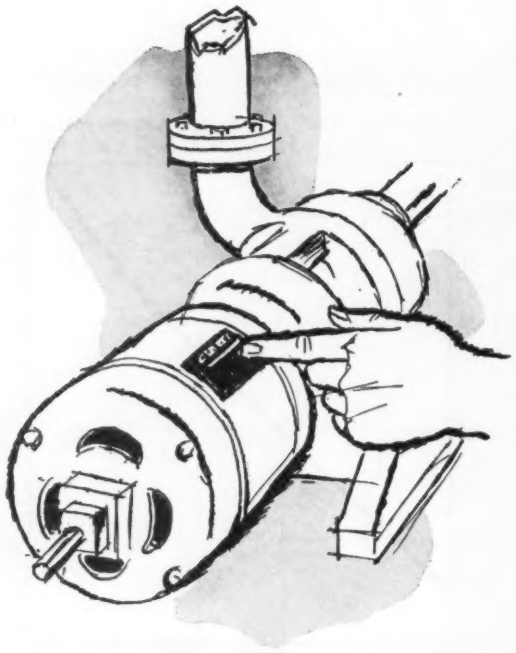


PERFORMANCE curves for the condensing-extraction turbine

Turn page for info on pump-motor ratings

More PLANT PROBLEMS

Begins on page 136



The question

Why does pump motor pull more current than nameplate rating?

When we ordered a motor-driven centrifugal pump recently, we specified a stainless-steel shaft.

After installing pump we found that the motor draws one-third more current than the nameplate rating. The plate-rating amperage is normal—7½ hp, 21 amp at 220 volt, 3 phase.

Manufacturer's answer to our complaint was to furnish another nameplate rating with a higher amperage—28 amp. We contend that the increased current is due to installing a nonmagnetic stainless steel that adversely affects the rotor's magnetic field. Magnetic type of stainless steel should have been used. What opinions do readers have on this matter? How can we avoid this condition?

—FCV, October Power

The answers

FCV's motor is overloaded

FCV's headache boils down to an overloaded motor. It could be due to over-size pump piping. Another possibility is too low discharge pressure.

Good check on this: Install a gage on pump side of the discharge valve. If discharge pressure is below nameplate rating, close valve until pressure climbs to rated-level figure. Check amperage. It should be back to normal.

We've operated pumps with the discharge valve sealed in a fixed position to avoid overloading motor.

P DAVIDSON *Ticonderoga, N. Y.*

Bilgewater on nonmagnetic steel shafts!

Before hunting for the obscure, *FVC* should try to eliminate the obvious. Motor manufacturers agree on one thing: You can be sure that motor amp should be 21 for a 7½-hp 220-v squirrel-cage motor.

Take a good look at pump manufacturer's characteristic curves. They show relation between gpm, head and horsepower. From these you'll see how quickly amps and gpm climb when head drops off.

A permanent orifice in the discharge line keeps head from getting too low. It works better than a fixed valve setting since setting can be accidentally disturbed.

W J STEINERT *Fresh Meadows, N. Y.*

I had a similar experience

In our plant a 440-v 47.5-amp 40-hp motor overloaded to 68 amp. Reason: Pump, designed for 225-ft head, was actually pumping against 175-ft head. Capacity naturally climbed, overloaded the motor.

Suggested cure: Put impeller in lathe and take a cut on it.

M T COLLETTE *Agana, Guam*

Voltage regulator can lick this headache

Neither magnetic nor nonmagnetic rotor material affects current drawn by pump motor. In motor design, path through the rotor isn't considered part of the circuit or field.

If *FCV's* motor is synchronous, then higher-than-rated current demand is result of field's overexcitation. This is because of either a leading or lagging current. In either case, line current exceeds rated.

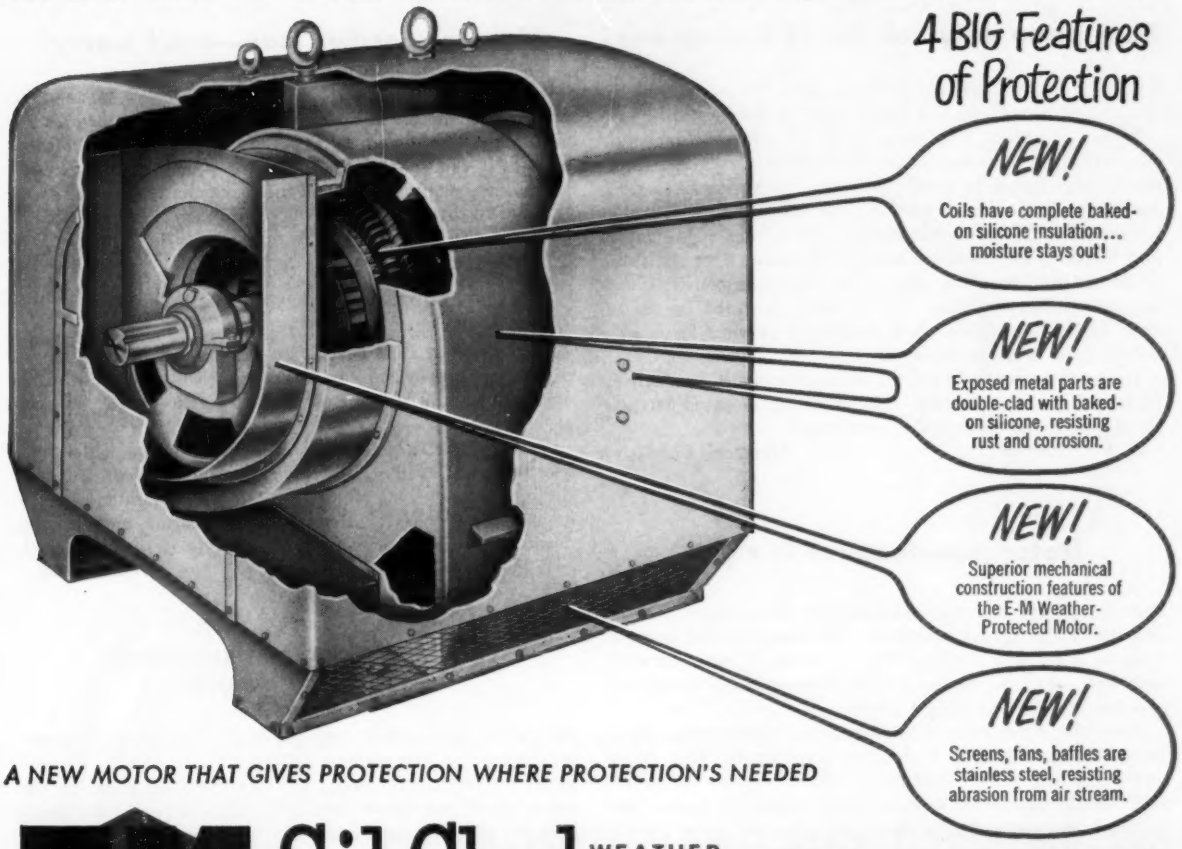
The condition can be reduced or eliminated with a voltage regulator to control the field. With regulator, when voltage drops off, because of plant's existing inductive load, synchronous motor's field strength climbs, raises power factor and maintains voltage at normal level. If voltage tends to rise because of line's capacity effect, regulator weakens the field, puts an inductive (lagging) load on the motor, holding voltage down to normal. *FCV* should try this setup.

A J BREUGELMANS *New York, N. Y.*

Turn page for more on pump-motor ratings, new problems

New E-M Silicone-Protected Motor

REPELS WATER AND RESISTS CORROSION, INSIDE AND OUT


4 BIG Features of Protection
NEW!
Coils have complete baked-on silicone insulation... moisture stays out!
NEW!
Exposed metal parts are double-clad with baked-on silicone, resisting rust and corrosion.
NEW!
Superior mechanical construction features of the E-M Weather-Protected Motor.
NEW!
Screens, fans, baffles are stainless steel, resisting abrasion from air stream.

A NEW MOTOR THAT GIVES PROTECTION WHERE PROTECTION'S NEEDED

E-M Sil-Clad WEATHER-PROTECTED INDUCTION MOTOR

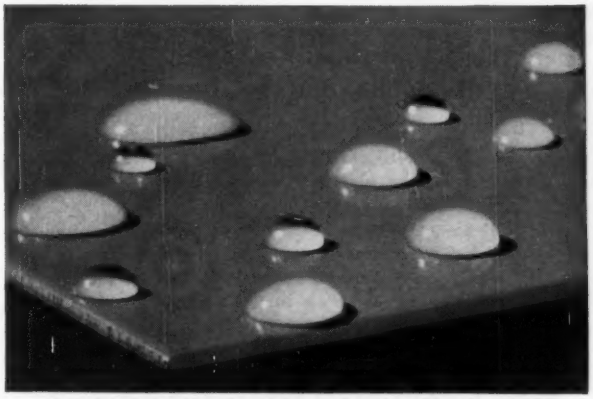
(250 hp and larger)

● Here's important news for engineers who would like to specify outdoor motors to minimize building costs at power stations, chemical plants, refineries, pipe lines, pulp and paper mills, smelters, seacoast industries, etc., but who have hesitated to do so because of adverse atmospheric conditions.

The important news is the E-M *Sil-Clad* Motor. It repels moisture penetration in wet, humid or steamy atmospheres. It resists corrosion from chemical fumes or salt air atmospheres. It resists oxidation from sun. In short, the complete silicone protection you get in *Sil-Clad* makes it possible for you to plan outdoor drives at a lower cost under conditions heretofore believed practicable only with the more expensive and not wholly protective totally-enclosed fan-cooled motors.

Get acquainted with the new *Sil-Clad* Motor now. In many cases it can substitute for outdoor totally-enclosed motors. *And Sil-Clad protection is offered on other E-M Motors too!* Ask your nearest E-M sales engineer for the complete *Sil-Clad* story . . . and write the factory for new Bulletin No. 217 which tells how the "wonder" properties of silicone are applied to full advantage in the great new *Sil-Clad* Motor.

ELECTRIC MACHINERY MFG. COMPANY
MINNEAPOLIS 13, MINNESOTA



SILICONE METAL PROTECTION REPELS WATER. See how the droplets of water pull away from the baked-on silicone coating. Coils and winding are silicone-protected, too, in the E-M *Sil-Clad* Motor.

1300-TPA-2178

Specialists in making motors do EXACTLY WHAT YOU WANT THEM TO!

More PLANT PROBLEMS

Begins on page 136

Does pump duty call for 10 horsepower?

I suspect that *FCV* needs a 10-hp not a 7½-hp motor. He should find out driver bhp from pump characteristics.

If driver bhp is 7½, then motor performance is below standard. Check power factor and temperature rise. Full-load power factor in good 7½-hp motors varies from 70% for 900-rpm machines to 85% for 1800-rpm. Allowable temperature rise above ambient is 40 C for open motors and 50-55 C for enclosed motors. If pump duty calls for 10-hp driver, then find out (from motor dimensions and nameplate data) whether 7½-hp rating is based on old or new NEMA standards. New standards provide for higher output from a given motor size.

If motor rating is based on old standards, it can deliver 10 hp without overheating. But if rating is based on new standards, motor is probably overloaded.

R A LEUCHTER *Montreal, Canada*

Motor manufacturer is right

With latest type motor insulations current variation, such as *FCV* talks about, isn't important. We can't say that because a motor is rated at 7½ hp, 220 v, 3 phase, it must draw 21 amp and no more. Motor may be conservatively rated and capable of handling bigger loads.

Since the manufacturer furnished the higher-rating plate he, no doubt, expects it to perform accordingly. If it failed under new nameplate conditions, he should replace the motor. *FCV* should change his control panel to conform to new rating and put motor on the line.

J F MAHER *Kirtland, New Mexico*

If motor handles load—don't worry!

Sounds to me like the trouble is caused by a mistake in marking the motor. If the manufacturer has furnished a new nameplate with higher rating—and the motor hasn't burned out—*FCV* can stop worrying. Motor producer undoubtedly knows the correct rating and motor capacity.

E A ROBERTS *Carlsbad, New Mexico*

Motor speed may be too low

Motor efficiency dips sharply in low-speed ranges. This is especially true in the smaller motor sizes. Net result: A motor that pulls 20 amp at 1800 rpm takes about 28 amp at 600 rpm.

Shaft material should have little effect on magnetic characteristics of the rotor. Rotor flux path is concentrated near the surface. On some motors the rotor is perforated or built on a *spider*, both to allow better ventilation and to trim down rotor's inertia. *FCV* can forget about shaft material.

W M MCMILLEN *Niles, Ohio*

Packing gland on pump shaft may be too tight

After *FCV* has checked out possibility of an overloaded motor because of manufacturer's mistakes, he should test his pump for mechanical drag. Too-tight packing gland on the pump shaft can cause overload. Motor-driven centrifugal pump of this size should turn freely by hand when idle.

V L NEALY *Mantua, New Jersey*

YOUR JANUARY PROBLEMS

What's good way to clean heat-exchanger tubes?

I was recently put in charge of heat-exchanger maintenance for a medium-sized chemical plant that also generates its own electrical power. We're big users of surface-type heat exchangers.

Until now, there has been little or no planning for heat-exchanger maintenance, especially tube cleaning. I'm convinced we could do a much better job by standardizing on cleaning methods, frequency and, possibly, fixtures that could speed up cleaning.

Typical heat exchangers in our plant include feedwater heaters, oil heaters and coolers, and chemical-process heaters. Tube materials vary from carbon and carbon-moly steels to copper alloys, monel, nickel and aluminum.

I would like to get detailed suggestions from *Power* readers on cleaning materials, techniques they've had success with. My aim is to set up procedures.—*MS*

2 Should we return condensate from our factory process?

Our power plant supplies about 50,000-lb-per-hr steam to production facilities. Use is at 125 and 10 psig for process and heating.

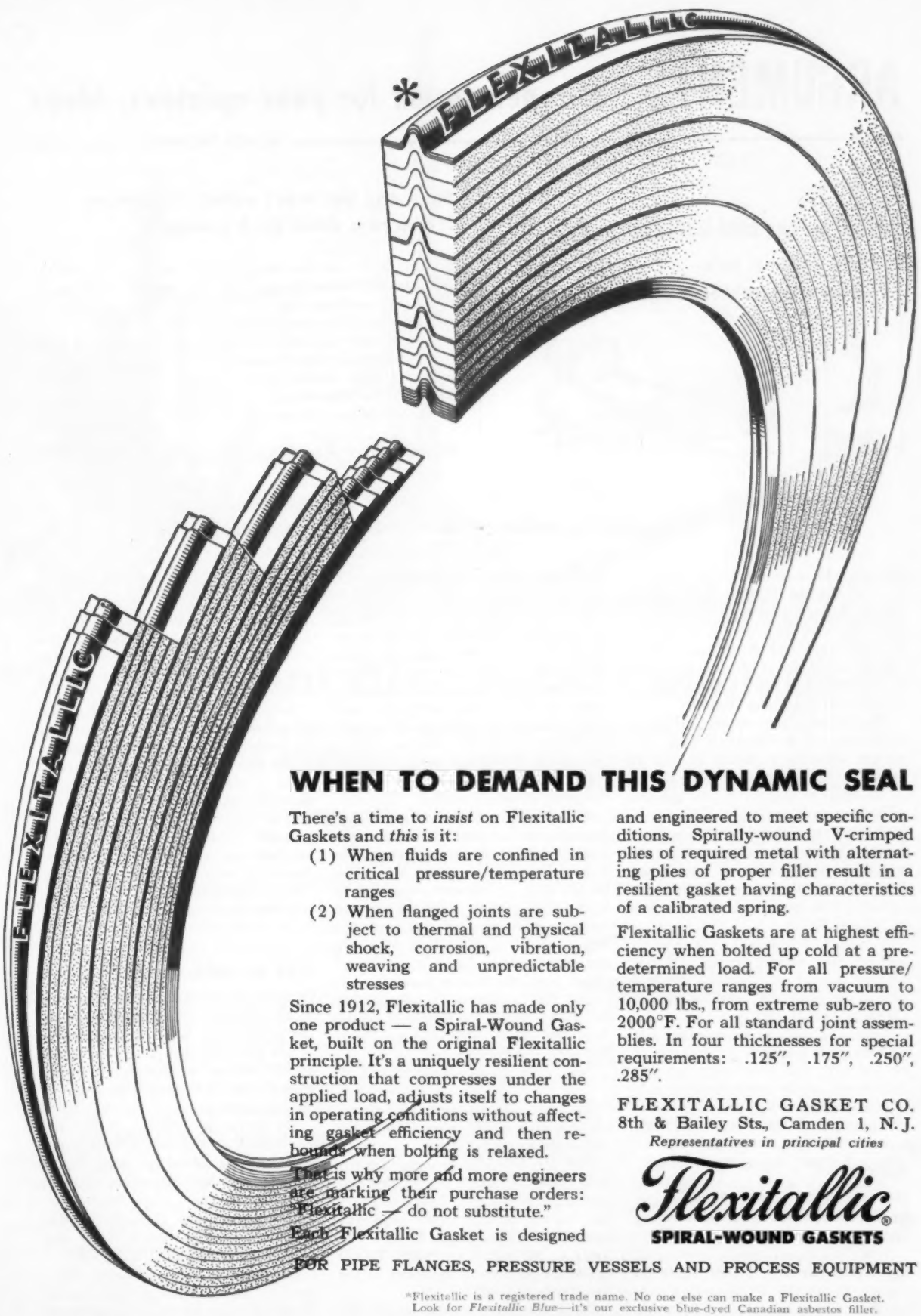
We haven't been returning condensate from the factory, mainly because some of it is oil contaminated. But also because we didn't want to invest in a condensate-return system.

As water costs—for both raw water and treating—continue to climb we're taking a second look at the picture to find out if we should go ahead with a return system, oil separators, etc.

Our plant is fairly well spread out. It covers about 15 acres. But boiler plant is centrally located. At best we could probably recover 60% of the condensate. Contaminants make balance useless.

We'd like *Power* readers' opinions on whether we should go ahead with the proposal.—*PRJ*

Sit down right now and answer one or both of these problems. We'll pay extra for answers with photos or sketches.



WHEN TO DEMAND THIS DYNAMIC SEAL

There's a time to *insist* on Flexitallic Gaskets and *this* is it:

(1) When fluids are confined in critical pressure/temperature ranges

(2) When flanged joints are subject to thermal and physical shock, corrosion, vibration, weaving and unpredictable stresses

Since 1912, Flexitallic has made only one product — a Spiral-Wound Gasket, built on the original Flexitallic principle. It's a uniquely resilient construction that compresses under the applied load, adjusts itself to changes in operating conditions without affecting gasket efficiency and then rebounds when bolting is relaxed.

That is why more and more engineers are marking their purchase orders: "Flexitallic — do not substitute."

Each Flexitallic Gasket is designed and engineered to meet specific conditions. Spirally-wound V-crimped plies of required metal with alternating plies of proper filler result in a resilient gasket having characteristics of a calibrated spring.

Flexitallic Gaskets are at highest efficiency when bolted up cold at a predetermined load. For all pressure/temperature ranges from vacuum to 10,000 lbs., from extreme sub-zero to 2000°F. For all standard joint assemblies. In four thicknesses for special requirements: .125", .175", .250", .285".

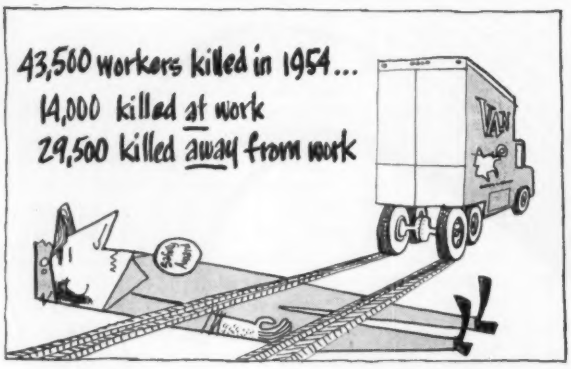
FLEXITALLIC GASKET CO.
8th & Bailey Sts., Camden 1, N. J.
Representatives in principal cities

Flexitallic®
SPIRAL-WOUND GASKETS
FOR PIPE FLANGES, PRESSURE VESSELS AND PROCESS EQUIPMENT

*Flexitallic is a registered trade name. No one else can make a Flexitallic Gasket. Look for *Flexitallic Blue*—it's our exclusive blue-dyed Canadian asbestos filler.

ARGUMENTS . . . *open forum for your opinions, ideas*

ALTHEA THORNTON, *Assistant Editor*



How can you work safely tomorrow if you're a dead duck tonight?

Workers suffer more accidental deaths and injuries off the job than they do on the job. In 1954, nearly seven out of ten deaths, and more than half the injuries occurred off the job, principally in motor-vehicle accidents.

Off-job deaths and injuries cause loss of production time, too, and generally these losses exceed those from work accidents. In 1954, workers injured off the job lost a total of 55,000,000 man-days compared with 40,000,000 man-days lost by workers injured on the job. —*National Safety Council*

EDITOR'S NOTE: *What is your plant doing to cut this toll?*

Three readers comment on recharging dry cells

The question about recharging dry cells (p 148, October POWER) brings back the old saying that there is nothing new under the sun. To prove this, I enclose a paper published in *Transactions of the Electrochemical Society* in 1938. It's called "The effect of applying a counter emf to a Leclanche cell."

This is just a high-sounding title for recharging an ordinary dry cell. We simply withdrew a certain amount of energy from a dry cell and then pumped in an equal or slightly greater amount of energy as direct current.

If you start with new dry cells, their life can be increased many fold by returning energy to the cell after it has been withdrawn. And also the cell voltage rises from normal 1.5 volts to values of 1.7 and higher.

Discussion at the meeting where paper was presented was interesting. Dr N K Cheney pointed out that this was old stuff to the battery industry, which had carefully kept it secret.

Textbooks continue to maintain that primary cells are good for removal of current only, and never point out that this energy can be replaced in the cell.

This procedure has proved possible and practical. Whether it is worthwhile is a matter of local economics.

PROF K KOBE *University of Texas*

Let me clarify some of the things George Pearce said about rejuvenating dry cells in October Arguments.

Actually a dry cell cannot be charged. *It loses its life long before losing its charge.* Check this by measuring voltage of a "dead" cell with an electronic voltmeter. Voltage is the same as that of a new battery.

The cell actually plays out before all the contained chemical energy is expended because a high-resistance oxide film forms around the center carbon electrode. This internal resistance prevents the battery from putting out any power. So life can be increased by driving off this oxide film. Adding heat to the battery will do this. A current flowing through the battery gives heat at the point where it's needed.

Whether this so-called recharging process can be justified depends on what percent of the normal battery life is used before light output is too low for the need. If you want a very bright light for inspection, it would not pay because a rejuvenated battery gives only about 85% of the light of a new one. But if you use batteries for normal patrol work, the process pays.

One big problem with rejuvenating batteries is to get the people to accept them who could adequately use them. Everyone wants a new cell.

PAUL FISHER *Grifton, N. C.*

I have heard many stories about charging dry cells. They always leave me with a *feeling of skepticism.*

The dry cell is a primary battery. It is a modification of the old zinc carbon-sal ammoniac cell. This forerunner lost capacity quickly when supplying current because hydrogen bubbles collected on the carbon electrode. This is one of the phenomena described by the term "polarization."

The effect was reduced in the dry cell by using manganese dioxide to react with the hydrogen and prevent bubble accumulation on the electrode.

The original wet cell could not be recharged because it lost an element in a form that could not be returned in a reverse chemical reaction.

In the dry cell, hydrogen is absorbed in nascent form and presumably lost by combination with the depolarizer.

The case for recharging seems prejudiced to me. I would like to see the chemical equations for this process.

Is it possible that the apparent rejuvenation is a side effect of the charging attempt, like mixing exhausted electrolyte with that which is not completely exhausted?

VICTOR JOHNSTON *Flushing, N. Y.*

Hot or cold water?

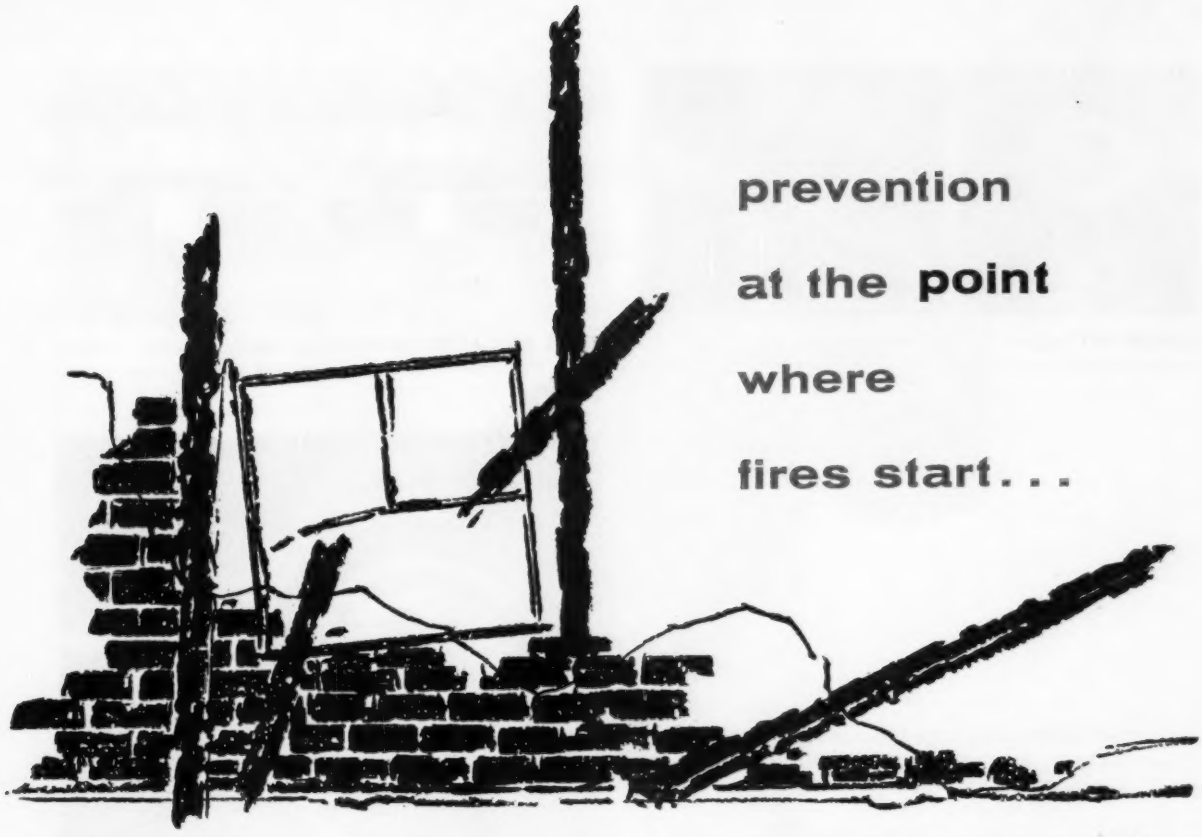
In filling cold boilers, I use hot water at 235 F from our feed heaters. I do this to save time. Some of the engineers in our plant say this is harmful to the boilers because it stresses the metal unevenly as the water comes up in tubes and shell.

My answer is, "Nuts!" A few riveted seams, on old Scotch boilers, did leak from hot water at times, but I can't see any harm from hot water in watertube boilers.

How about some ideas from other readers? What is hottest water you would use in what kind of boilers?

J F ATWELL *Chicago, Ill.*

EDITOR'S NOTE: *What do you readers think? We pay for answers published.*



prevention

at the **point**

where

fires start . . .

Fire-resistant Celanese* Cellulubes*

Synthetic lubricants and power transfer fluids now available in 6 controlled viscosities

Celanese Cellulubes are fire-resistant synthetic oils, designed to provide protection against fire hazards and explosion inherent in many industrial operations.

As air cylinder lubricants in compressed air systems, Cellulubes prevent the formation of excessive carbon deposits—No. 1 source of compressor fires and explosions. They are excellent lubricants—highly stable, non-corrosive, non-foaming.

As the hydraulic fluid in diecasting and similar critical operations, Cellulubes reduce the ever-present danger from uncontrollable fires due to line breaks or other failures. Chemical compounds that contain no additives, Cellulubes' physical properties are exceptionally stable under continuous duty.

6 CONTROLLED VISCOSITIES

With the expansion of the Cellulube series to 6 controlled viscosities: 90, 150, 220, 300, 550, and 1000 (S.U.S. @ 100° F.), the way is open to replace flammable fluids in many hazardous applications. If you would like to evaluate Cellulube in your own operation, use coupon below to order working samples and complete use data. Celanese Corporation of America, Chemical Division, Dept. 597-A, 180 Madison Avenue, New York 16, N. Y.

Celanese* CHEMICALS

*Reg. U.S. Pat. Off.

Celanese Corporation of America, Chemical Division, Dept. 597-A, 180 Madison Avenue, New York 16, N. Y.

Please send me working sample and technical bulletin on Cellulube for air compressor service____ for hydraulic systems____. Send technical representative____.

Name_____

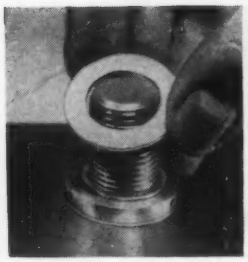
Title_____

Company_____

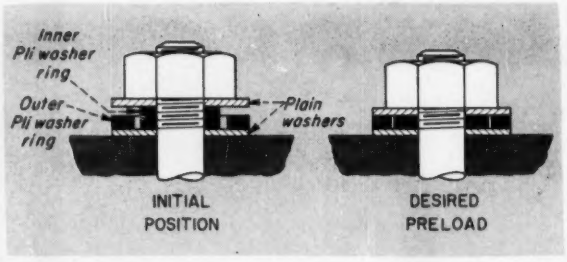
Address_____

City_____ Zone____ State_____

▶ **CAREERS . . .** IN RESEARCH, ENGINEERING, PRODUCTION AND SALES. Write Personnel Department "F" for a copy of "Celanese Careers."



TIGHTEN NUT against *Pli* washer assembly until inside ring is compressed so outside ring cannot be moved with pin shown



BEFORE AND AFTER tightening *Pli* washer assembly. Preload here is about twice the average you get with a torque wrench

HOW TO

get tighter, longer-lived bolt joints

TWO CONCENTRIC STEEL RINGS make up this *Pli* washer assembly. They preload the bolt to 80% of its yield strength. This means tighter joint, longer bolt life

► Now, here's automatic preload-indicating device that's integral part of your nut-and-bolt connection. It allows more accurate tightening and higher preloading of joints than the usual torque wrenching. Assembly is two loosely fitting steel rings. One is compressed under load, indicates desired preload automatically. It's also simpler and faster than to find preload by measuring bolt strain with micrometer.

High accuracy, plus or minus 10%, permits safe preloading to 80% or more of bolt yield strength. This high preloading means tighter, sounder connections and longer bolt life. Result—more complete use of a bolt's inherent strength. Some jobs may need fewer or smaller bolts.

In use, this *Pli* washer is sandwiched between two plain washers at either nut or bolt end of connection. As you tighten, you compress the inner ring (higher than the outer ring). Endpoint is reached when inner ring compresses to height of outer ring. Outer ring then binds against adjacent washers.

A feeler pin, inserted in hole, is used to wiggle outer ring while tightening. When ring no longer moves you have reached endpoint. Dimensions of *Pli* washer depend on diameter, thread and ultimate tensile strength of bolt and on desired preload. Device adds little to height of assembly. Loaded *Pli* washer for No. 10 bolt is only 0.076 in. thick. Height of larger sizes, up to 1½-in. bolt diameter, increases about 0.010 in. for each 1/16-in. bolt diameter.

These washers are made to indicate any desired preload in a variety of bolt types ranging in tensile strength from 80,000 to 240,000 psi maximum.

Courtesy, Standard Pressed Steel Co

WHAT TO LOOK FOR IN A HIGH PRESSURE-- HIGH TEMPERATURE STEAM TRAP....

High pressure—high temperature service is no place to cut corners, no place to to take chances. Here are some things to think about in specifying steam traps:

1. Experience—Since right after World War One, Armstrong trap development has kept pace with the trend to higher and higher pressures and temperatures. These traps are the most widely used of any in leading power plants throughout the world at pressures up to 2400 psig—there is no finer endorsement.

2. Design—The simple, dependable Armstrong inverted bucket mechanism provides the closest thing possible to 100% assurance that the trap will not fail to open for condensate and close for steam. Extra heavy forgings provide large safety margins.

3. Materials—see list at left.

4. Price—Armstrong forged steel trap list prices range from $95 to over $1000. The No. 515 shown above is rated for 1500 psig at 900°F and for 2000 psig at 600°F. It lists at $500. Armstrong prices are moderate for what you get because of high production. *There is no compromise made at the expense of safety, quality and low maintenance.*

Want more facts?—Call your local Armstrong Representative or write: Armstrong Machine Works, 812 Maple Street, Three Rivers, Michigan.

Do you have Catalog J?—This 44-page Steam Trap Book is free on request.

LIST OF MATERIALS
ARMSTRONG FORGED STEEL TRAPS

Part	Material
CAP AND BODY FORGINGS	
Up to 600 psi, 750°	1030 carbon steel
Up to 900 psi, 900°	ASTM Spec. F-1 carbon moly steel
Up to 2500 psi, above 900°	ASTM Spec. F-5 chrome moly steel
VALVE AND SEAT	Type 440 chrome steel, heat treated, standard. Stellite available.
LEVER MECHANISM	Stainless steel
BUCKET	Stainless steel
BOLTS	Class C high tensile, high temperature bolting material—125,000 min. tensile.
NUTS	Hex, semi-finish, heat treated for high pressure, high temperature service.
GASKET	Compressed graphited asbestos
INLET TUBE	Wrought iron

STEAM TRAPS FOR EVERY REQUIREMENT — APPLICATION ENGINEERED

ARMSTRONG STEAM TRAPS

BASICS . . . *bringing engineering theory down to earth*

HOWARD KALLEN, *Assistant Editor*

FLUID FACTS — 5:

How flow affects fluid's energy

► FRICTION AND ENERGY LOSSES that make frictional effects evident play a key role in fluid-flow problems. That's why researchers have been studying fluid friction in valves, fittings, pipe for years—trying to come up with a reasonably accurate accounting of frictional-energy losses.

But the engineer often solves flow problems without tapping experimental data on friction, because he needs only a rough answer, or accurate information just doesn't exist. He assumes fluid is frictionless, comes close enough to actual conditions for his needs.

In this installment we're going to focus on these frictionless fluids. A close look not only shows us how to get within shooting range of accurate answers, but also throws light on an important problem: What happens to the energy of moving fluids?

We'll put one further limitation on our present study: Fluid density doesn't change—the liquid or gas we're dealing with can't be compressed. Assuming constant density simplifies the problem. And we can still apply formulas in succeeding paragraphs to liquid flow, gas flow where pressure and temperature changes are small (density is almost constant).

Continuous flow. Drawing, top right, shows flow through a varying-cross-section pipe. Streamlines showing flow are packed close together where pipe is narrow, spread out as pipe's sectional area increases. Relative distances between these lines are an index of flow velocity. Tightly packed streamlines: high velocity. Spread-out streamlines: low velocity.

But, regardless of velocity, flow rate is same in small and large pipe sections, unless we add a pump or other device that changes total fluid energy. So velocity and sectional area at all points along the pipe must be related in a way that yields constant flow rate:

$$A_1 V_1 = A_2 V_2 = Q \qquad (1)$$

where

A_1 = pipe sectional area at 1, sq ft
V_1 = fluid velocity at 1, ft per sec
A_2 = pipe sectional area at 2, sq ft
V_2 = fluid velocity at 2, ft per sec
Q = flow rate, cu ft per sec

Formula says, in effect, that as sectional area increases, velocity drops off. Notice that the formula is consistent with the meaning we gave to closely packed and spread-out streamlines.

Because (1) states requirements for continuous flow, we call it the continuity equation. It's a useful tool in many flow problems, as we'll see later.

Energy accounting. If total energy of this virtually frictionless liquid we're working with doesn't change as it flows through the pipe (no frictional losses and no addition or removal of energy through pumps or turbines), we can keep tabs on energy due to (1) pressure (2) velocity (3) liquid's elevation —potential energy. Sum of the three remains constant, but distribution varies. By dealing with an incompressible fluid we needn't consider energy change due to temperature — internal energy—since it remains constant along the pipe run.

Drawing, center, right, shows how energy distribution varies as elevation, pipe sectional area change. But note that total energy line remains horizontal—unchanged. Formula relating various energies shown is called the Bernoulli equation. It says:

$$p/d + V^2/2g + Z = \text{constant} \qquad (2)$$

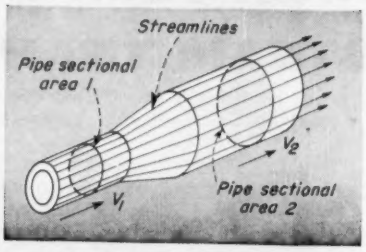
where

p = pressure, lb per sq ft
d = density, cu ft per lb
V = velocity, ft per sec
g = gravity constant, ft per sec^2
Z = elevation, ft

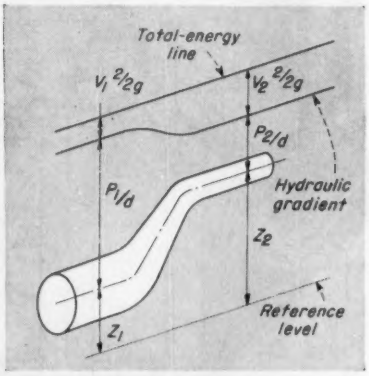
First energy term in (2) is liquid's pressure head. Second is velocity head. Z is potential head. Dimensional check shows that all three energy terms read in energy per pound of liquid flowing or, simply, just feet.

By installing static and impact tube connections along pipe run we can measure the static and total energy levels directly. Subtracting these two yields velocity energy. Bottom drawing shows such an installation.

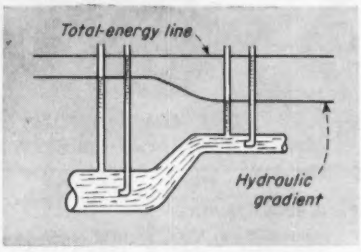
Next month we'll put Continuity and Bernoulli formulas to work on some practical engineering problems.



STREAMLINES' SPACING indicates the flow speed. Small space = fast flow



ENERGY DISTRIBUTION of a flowing fluid changes as it moves along the pipe

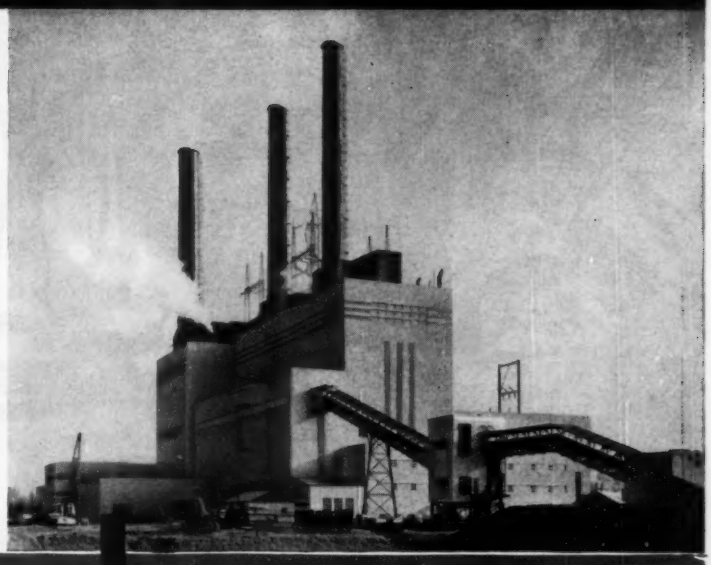


STATIC, TOTAL PRESSURES are a measure of the fluid's pressure, total energy

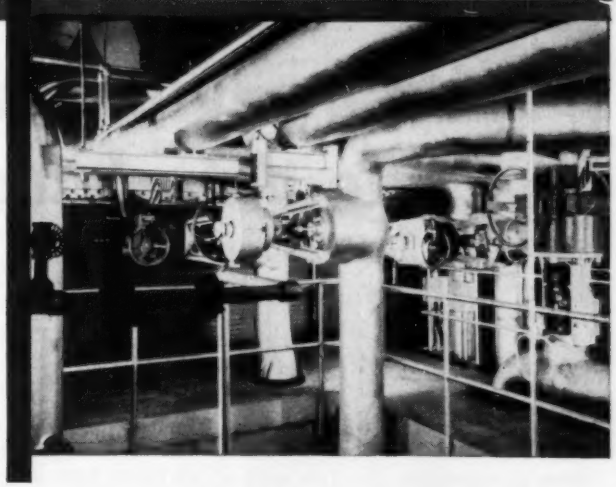
LUNKENHEIMER BREECH LOCK VALVES

serve the world's most efficient power plants!

THIS TANNERS CREEK PLANT is one of four new and modern power stations in the system of 12 major plants of the American Gas and Electric Company. In 1954, these four similar plants ranked among the top seven of the world's most efficient power stations, generating more electricity per Btu than any other stations anywhere — and for five consecutive years, beginning in 1950, one or another of these plants has been first!



The Lunkenheimer Breech Lock Valves shown here help maintain this performance record by controlling the flow of 450° feed water at pressures of 2,700 pounds per square inch in the Tanners Creek plant. Other Breech Lock Valves, as well as hundreds of Lunkenheimer Bronze, Iron, and Steel Valves for lower pressures, are used in other plants of the American Gas and Electric System.



LUNKENHEIMER QUALITY

WRITE FOR LITERATURE describing the unique interlocking-lug design which makes Breech Lock far easier to service and maintain than any other high-pressure seal-weld valve. Address: The Lunkenheimer Co., Box 360, Cincinnati 14, Ohio.

STEEL • BRONZE • IRON • PVC

LUNKENHEIMER®

THE ONE *Great* NAME IN VALVES

L-755-12

"I can stop that damn leak and I don't need all this fancy metal and rubber haberdashery," Marmy roared

Marmy plugs the dam leak

► Too BAD all the older power engineers who retire can't hand over their years of experience. It seems such a waste to have a lifetime of know-how taken out of circulation. I guess one good exception, though, is our own Marmaduke Surfaceblow, that cantankerous old consulting engineer.

Marmy has knocked about this globe for more years than we know. According to the dates he quotes, he must be close to a hundred. But if we go by his looks and his capacity to keep himself embalmed with Sandpaper Gin, he's right in his prime—at least he can stand up to any man we've seen hereabouts, only no one stands up to him.

The lumberjacks have their Paul Bunyan and the marine engineers have their Colin Glencannon. But we power engineers have a combination of both in Marmy. And we've got reason to believe the bellowing old bull will be sounding off in his foghorn voice many years after most of us are firing up from down below.

His experiences are those of all power engineers—both ashore and afloat—rolled into one. And the old boy has been dishing them up each month for posterity. By putting them in print, I'm sure they'll be floating around long after Marmy has raised steam on this old planet for the last time.

Here's a story Marmy sounded off about last week. I wasn't at Bedlam's Bent Propeller Bar to hear him, but it's straight from his old shipmate Bedlam himself. As usual, he stopped the works by yelling BILGEWATER and blasted away without anyone daring to interrupt him.

"Back in 1922, I left my ship in Seattle and started out on a cross-country tour by side-door pullman. I picked up odd plant jobs along the way to keep the wrinkles out of my belly. One hot morning I got out of a sheep car in a Western state and saw a large hydroelectric plant down the valley.

"It turned out to be one of the biggest dams in those days. Two thousand men had sweated four years to build her. The last dam opening was closed the winter before. Then water had risen upstream during heavy rainfalls into a 65-mile lake.

"The erection super turned out to be a live-wire engineer I had signed on a round-the-world merchant ship as a coal passer during his college days years before. He was glad to see me and put me on the payroll to help get the plant ready to roll. But his work was done and a few days later he was sent to a Canadian job.

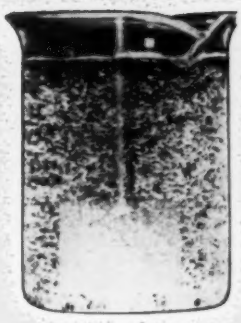
"After I was around a few months the lake upstream rose to its top level and put service pressure on all parts of the dam. During this time the gang kept an eagle eye for weaknesses on

(*Continued on page* 190)

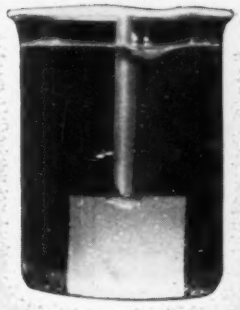
A New, Better Coagulant

NALCO 600

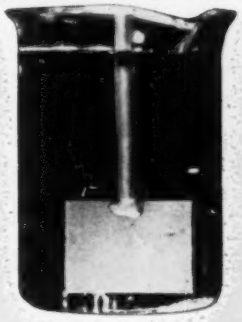
POLYELECTROLYTE



Alum



Alum plus
typical polyelectrolyte



Alum plus
Nalco 600

As a coagulant in water clarification, and under many process coagulation conditions, new and different Nalco 600 has shown such great promise, both in performance and economy characteristics, that it has now been made available for general use as an established member of the Nalco family of chemical aids to industry.

Extremely difficult coagulation conditions provide especially economical applications for Nalco 600. It can be used alone or in conjunction with other coagulants. A very low dosage of Nalco 600 usually permits as much as 50% reduction in dosage of alum, activated silica, iron sulfate or clay type treatments . . . and results in a cleaner, clearer supernatant liquid.

Nalco 600 was invented in the Nalco Laboratories, and is being manufactured *only* by Nalco. For complete data on Nalco 600, and expert technical assistance to solve your clarification and coagulation problems, call Nalco now.

NATIONAL ALUMINATE CORPORATION

Telephone: POrtsmouth 7-7240

6222 West 66th Place • Chicago 38, Illinois

IN CANADA: Alchem Limited, Burlington, Ontario

NORTHWESTERN UNITED STATES, HAWAII and ALASKA
The Flox Company, Inc., Minneapolis 3, Minnesota

ITALY: Nalco Italiana, S.p.A. SPAIN: Nalco Espanola, S.A.

WEST GERMANY: Deutsche Nalco-Chemie GmbH

ANOTHER *Nalco*® **PRODUCT. Serving Industry through Practical Applied Science**

JENKINS Fig. 106-A

Renewable Composition Disc
BRONZE GLOBE VALVE
150 lbs. Steam 300 lbs. O.W.G.
1/8 in. to 3 in.

Making a Workhorse a Champion

Take a Fig. 106-A apart. It's easy to see the reason why it's the "champion" of disc-equipped Bronze Globes. Every part, from heatproof handwheel to pipe ends, reflects the design and construction skill of generations of Jenkins Valve specialists.

Fig. 106-A not only looks better — it proves out better in performance. In any comparision, its long-life, low-upkeep record has always set the standard. That is the true measure of valve cost — and it is the reason why industry's shrewdest buyers will settle for nothing less than Fig. 106-A quality.

the FIRST
Renewable Composition Disc Globe Valve

Industry's all-time champion for long-range economy

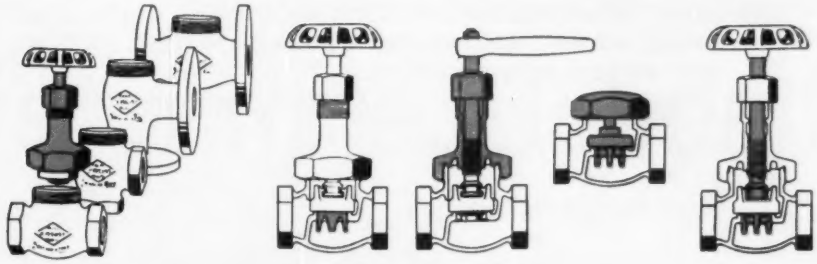
Work horse of industry's pipelines is the renewable composition disc Bronze Globe.

Jenkins valve specialists have always taken a special view of this type of valve. It dates way back to the time when Jenkins introduced the *first* renewable composition disc Bronze Globe. In fact, Jenkins is still the only manufacturer of both valves *and* discs.

Jenkins engineers reasoned that the valve that has most of the work to do should have a liberal extra measure of dependability. The result is Fig. 106-A. It has all the rugged endurance of a work horse. But it also has the fine form, the lasting sensitivity of control — all the characteristic features of a champion.

That's why it is the leading choice of valve-wise buyers throughout industry. Test the Jenkins 106-A "family" on your toughest services. See why they are your best buy for lasting valve economy.

Ask your Jenkins Distributor for full information, or write: Jenkins Bros., 100 Park Ave., New York 17, N. Y.



One Good Valve Becomes Another . . .

The Fig. 106-A "family", with interchangeable parts, provides patterns to meet 90% of average valve needs.

Trimming is interchangeable in Globe or Angle body, screwed or flanged. With a few parts, quickly assembled combinations provide a Lift Check, a Spring-loaded Check, and valves for Stop and Check, Quick-opening, or Throttling service.

JENKINS VALVES

LOOK FOR THE JENKINS DIAMOND TRADE MARK

SINCE 1864

Jenkins Bros

SOLD THROUGH LEADING INDUSTRIAL DISTRIBUTORS

Reader service section

Start with these quick samples . . .

Like to cut fuel bills . . .

by $59,000 annually? That's what they're doing at AEC's Hanford atomic plant by using tremendous quantities of waste heat – generated by atomic reactors – for large-scale space heating. It's the first application of its kind in the U. S.

Reports From the Field, p 154

Solar energy – what's its fate?

To get a line on what's happening and what's expected to happen in this promising field, skim the latest technical papers – briefed for you by POWER editors. Other reports, 23 in all, relate to steam power, bearings, heat transfer, fuels.

Technical Briefs, p 156

Pushbutton industrial TV . . .

is providing, among its many features, operator safety, wide coverage, quick viewing. Two remote-control systems are pinpointed for your attention. Other featured items are designed to solve plant cooling and ventilating, valving, refrigeration problems. Facts on these and other improved products.

Plant Equipment News, p 160

Best things in life . . .

are free – and here are some 30-odd items that are yours for the asking. Cataloged and digested for quick review, are the latest manufacturer's bulletins, covering all phases of the power field. To get those you want use handy reader-service post cards.

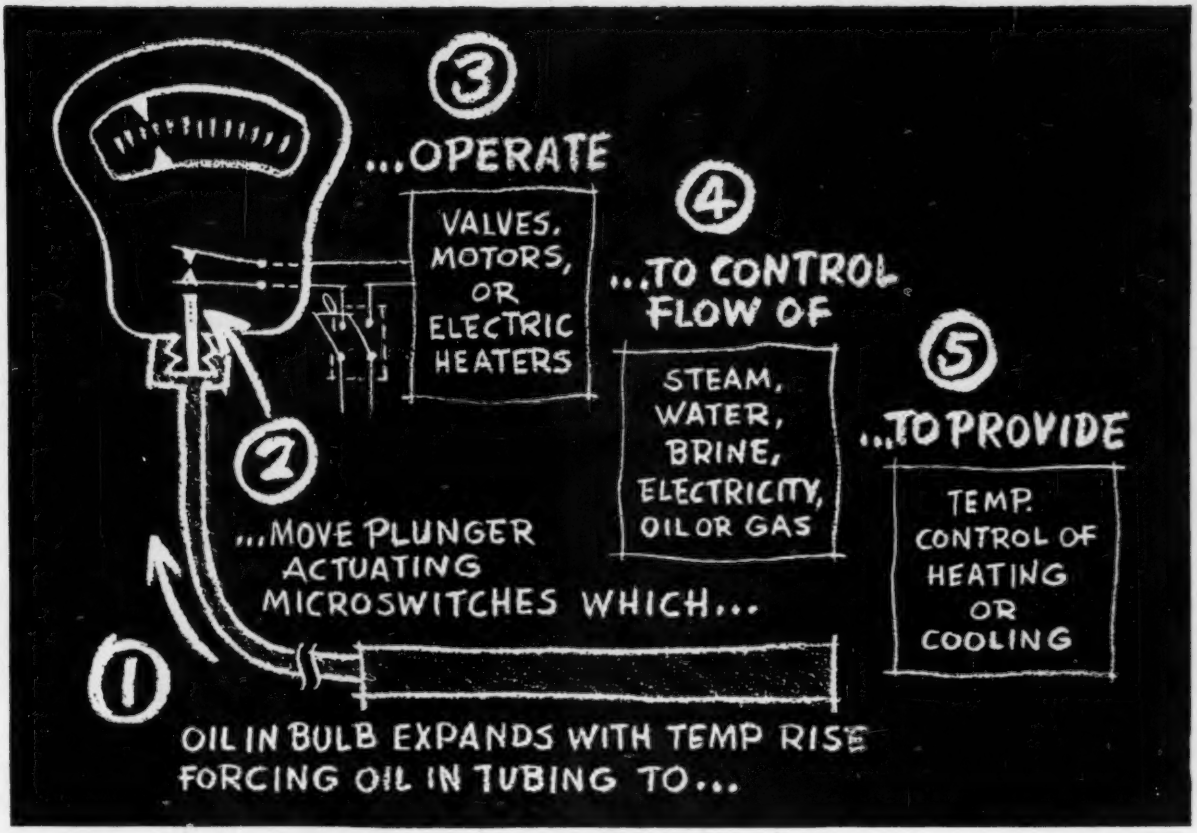
Free Literature, p 169

What's modern today . . .

is obsolete tomorrow. And, according to George Edwards, engineer-philosopher, this is doubly so when applied to the fast-changing power field. He quotes a famous Queen who once said, "It takes all the running you can do to stay in the same place." Are you running fast enough to stay ahead?

George Edwards' Scrapbook, p 172

For other timely ideas, see following service pages ▶



INDICATING

Automatic / Temperature Control

It's simple...dependable!

That rough sketch above tells the story. It shows Sarco's simple electric indicating temperature control . . . and what it can do for you.

Really mighty simple, isn't it? Yet, it's adjustable, indicating and provides dependable accuracy to ± ½°F. No gadgets that call for a technician to read and repair! So simple, so trouble-free . . . maintenance is seldom, if ever, needed.

Turn one knob to change the temperature control setting. Large, easy-to-read scale shows you both the actual and the set temperature.

SEQUENCE CONTROL

And this Sarco electric temperature control is versatile . . . it offers you many sequence combinations such as:

- **Step-heating**
- **Heating and cooling**
- **Wide limit control**
- **Temperature control plus operation of signal devices**

Cost . . . only about $100! It's good economy to specify AUTOMATIC temperature control for ALL control jobs, not just the big ones. So mail the coupon now for complete information.

SARCO

Sarco Company, Inc., Empire State Bldg., New York 1, N. Y.

Please send information on your simple, inexpensive temperature controllers:

☐ Self-powered type for use on_____

☐ Electric indicating type for use on_____

Name_____

Firm_____

Address_____

City_____ State_____

2147-B

REPORTS FROM THE FIELD

What's happening in power and what it means to you

For Calendar of Events see page 244

First full-scale use of atomic heat

► FOR THE FIRST TIME in U.S. history tremendous quantities of waste heat generated by atomic reactors are being used for large-scale space heating.

General Electric scientists and engineers at the Atomic Energy Commission's Hanford plant are transferring heat—from water used to cool atomic reactors—to air conditioners in various Hanford buildings. Several buildings are heated by the system with about half going into a single structure housing a large reactor that produces plutonium. Equivalent heat would be sufficient to fill the needs of more than a thousand average-size homes. GE engineers estimate that the buildings to be heated use about 168,000 cu ft of outside air a minute. The system works like this:

Water from the Columbia River is pumped through Hanford reactors used in producing plutonium. In cooling these reactors, the water absorbs immense amounts of heat and picks up slight amounts of radioactivity—both derived when atoms of uranium fission or become plutonium.

Reactor cooling water is pumped to a heat exchanger that transmits the heat to air-conditioning systems in the various buildings. Reactor cooling water is held until its radioactivity level has decreased to a point where it can safely be discharged to the river. Ethylene glycol is used to prevent freezing in the outside bank of air-conditioner coils during sub-zero weather.

Safety of the system is assured by maintaining higher pressure in the secondary or ethylene-glycol system than in the system pumping water directly from the reactor. If a leak should develop, flow would be from the non-radioactive fluid into the radioactive fluid —preventing any leakage of radioactive water from entering into the heating system.

The entire system is expected to save $59,000 annually in fuel costs, although initial investment—about $614,000—is more than would be needed to construct a conventional heating plant. The added cost for atomic heating is $444,000—but savings over a few years is expected to defray this extra initial expense.

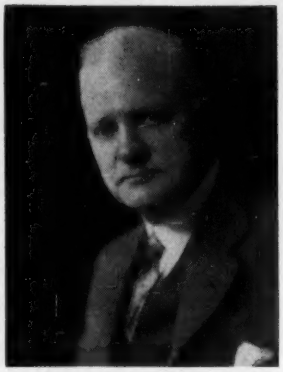
Plan to build 85,000-kw hydro plant

► APPLICATION TO THE Federal Power Commission for a license to build an 85,000-kw hydroelectric plant on the Upper Baker River has been announced by Frank McLaughlin, president of Puget Sound Power & Light Co. Estimated cost of the project is more than $27 million.

The proposed dam, some 300-ft high, would be located about 90 miles north of Seattle, Wash, about eight miles above the company's present Baker River project. It would impound approximately 238,000 acre-feet of water in a reservoir nine miles long. This will permit another 55,000 kw to be added to the present Lower Baker plant. The two projects will total 140,000 kw of new generation at an estimated cost of $35 million.

When FPC issues the license, plans will be carried out to begin construction early next spring. Completion of the entire project is scheduled for 1959.

(*For More Reports From the Field, turn to page* 240)



Ely Champion Hutchinson, former POWER editor, dies

► ELY CHAMPION HUTCHINSON, 73, editor of POWER from 1929 to 1933 and nationally known industrial executive and management consulting engineer, died in Emergency Hospital, Washington, D.C. on November 12 of a heart ailment.

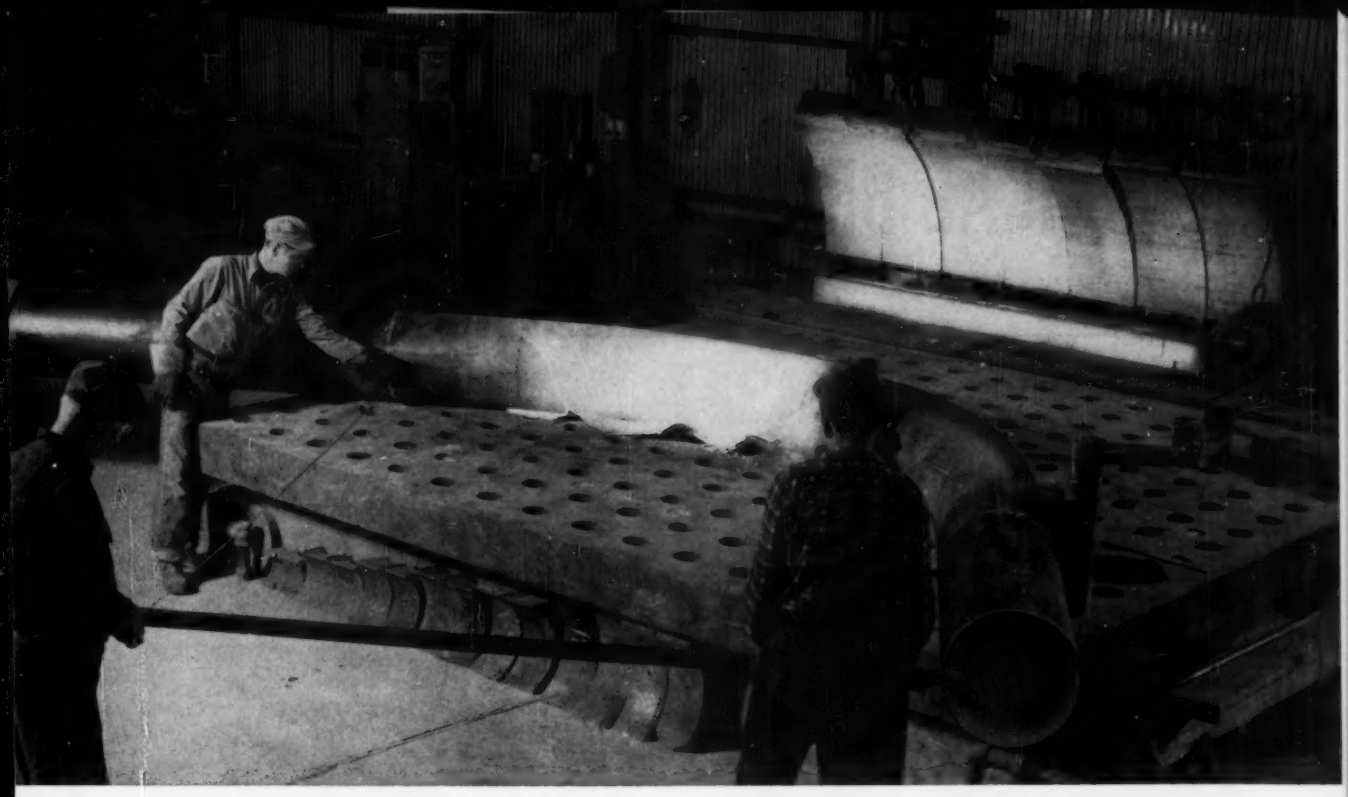
The self-educated technician began his business career as a pattern maker's apprentice, worked successfully as a draftsman and then as a designer of engines, compressors, hoists and mining machinery. From 1908 to 1929 he was associated with the Pelton Water Wheel Co, San Francisco, where he rose to the presidency and general managership.

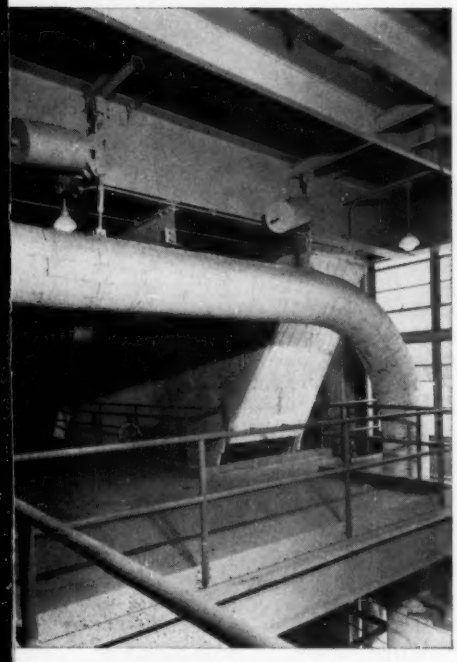
In 1929 he moved to New York, joined the McGraw-Hill Publishing Co, and was appointed editor of POWER.

He resigned in 1933 to become president of the Edge Moor Iron Co, Edge Moor, Del. Later he joined the J G White Engineering Corp, New York and for a time was manager of Alco Products, Inc, N. Y.

During World War II, Mr Hutchinson engaged in governmental and public service as a consultant in technical and scientific affairs. Inventor and patentee of numerous mechanical devices used in hydraulic engineering, he was a fellow and former vice-president of the American Society of Mechanical Engineers and a member of the American Society of Civil Engineers. He served as chairman of the New York Committee of the Third International World Power Conference. He had been living in retirement for the past few years.

Surviving are his widow, Florence, and a daughter, Mrs. Henry C Alexander.





This station, having an initial capability of 276,000 kw, was designed and erection supervised by Gilbert Associates, Inc., Reading, Pennsylvania. It is one of the most efficient and low-cost stations in the country.

At the new Shawville Station of Pennsylvania Electric Co.

it's NAVCO Piping throughout

Over 37 miles of pipe were installed by Navco in this highly efficient reheat station and all necessary prefabricated assemblies, in excess of 2,000,000 lbs., were produced in Navco shops. For field welding only, more than 15 tons of electrodes were used.

The photo above shows one of the bends required for the Main Steam. It is 16″ O.D. forged and bored with a wall thickness of 3.084″ and weighs 5½ tons. Material is ASTM A-335 P-22—2¼% Chrome. Operating conditions are 1850 psi at 1050°F. initial, with 1000°F. reheat.

The photo at the left shows this bend in service supported by dependable Navco Counterpoise Hangers.

In the past three years alone, Navco Piping has been installed in Central Stations generating in excess of 4,000,000 kw.

Next time you have a Piping job requiring reliability in performance and careful attention to every small detail, Navco will welcome the opportunity of quoting you.

Call, wire or write today!

NAVCO

NATIONAL VALVE & MANUFACTURING COMPANY

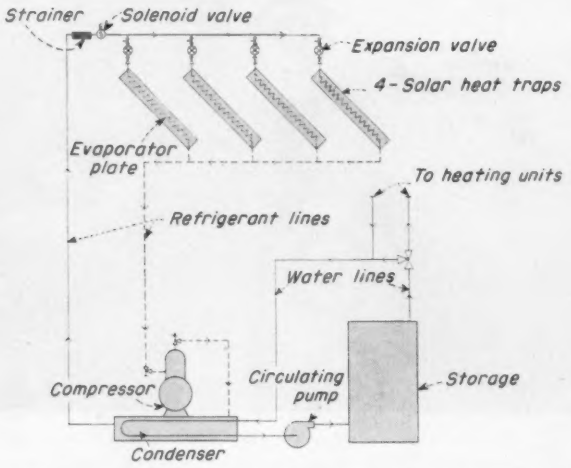
3105 LIBERTY AVENUE, PITTSBURGH 1, PENNSYLVANIA

New York • Chicago • Cleveland • Boston • Atlanta • Buffalo • Cincinnati

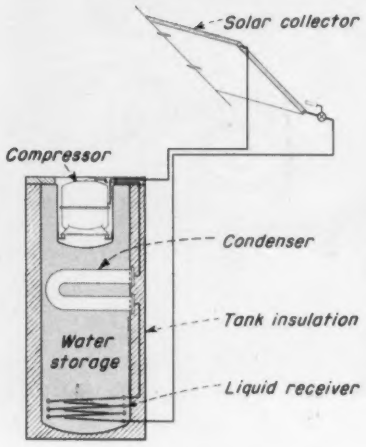
TECHNICAL BRIEFS

Latest engineering developments for busy power men

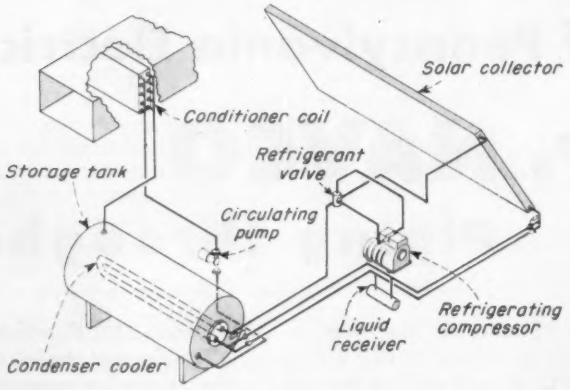
23 Papers for you on:
SOLAR ENERGY
STEAM POWER
BEARINGS
HEAT TRANSFER
FUELS



1 Heating system using solar energy for its source of energy



2 Solar unit for heating hot water



3 Summer cooling system uses solar collectors, refrigeration

Solar energy — what is its future?

Design and performance of a solar collector heat pump. *By Phillip Sporn and E R Ambrose, American Gas and Electric Service Corp.*

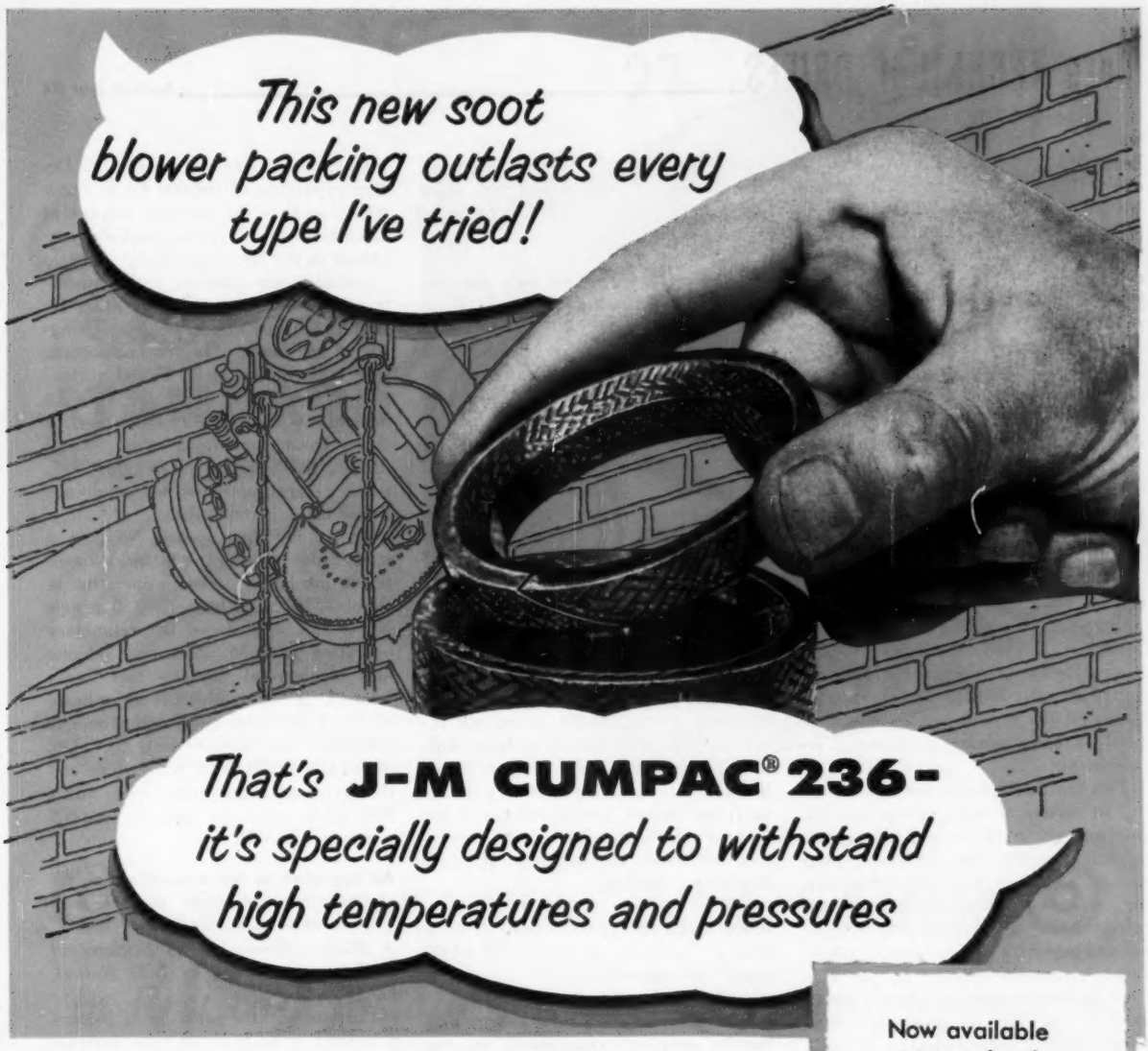
A practical and acceptable solar heating system must have a high collector efficiency, be relatively free of operating and maintenance troubles and be competitive in first cost with other heating systems.

The heat pump offers several possibilities for overcoming some of the present handicaps facing the direct-utilization collector. It has the inherent ability to maintain a relatively low collector temperature. Operating at lower temperatures reduces transmission losses which, in turn, materially increase collector efficiency. At the same time, lower collector temperatures permit obtaining a larger percentage of the lower intensity solar energy occurring during early morning and late afternoon hours, and on cloudy days.

Fig. 1 shows the heat-pump flow diagram of a hookup used in a series of field tests in which solar and sky radiation were collected. Note that the operating cycle is identical to a conventional refrigeration cycle. The compressor circulates refrigerant between the evaporator, which is kept at about 60 F, or lower, and the condenser, which is usually at 110 F, or higher. Solar and sky radiation cause refrigerant to change from a liquid to a gas in the solar heat traps (evaporators). Refrigerant then gives up its latent heat of vaporization to circulating water in the condenser. Heated water is delivered from the storage tank to the heating system.

Same surface used as a heat source for winter heating can be easily adapted to serve as a heat sink for summer cooling. Fig. 3 shows such an operating cycle. Compressor furnishes summer cooling, as well as winter heating by means of a valve that changes direction of refrigerant flow. Collector plate, free of glass covers or enclosures, can be mounted in a vertical position facing south. It can serve as part of the building's roof or sidewall without detracting from appearance.

Same collector-condensing unit combination as in Fig. 3 can be used for heating domestic water. Water heater can be combined with year-round comfort air-conditioning system or made a separate self-contained unit. Fig. 2 shows one possible solar-heat-pump


This new soot blower packing outlasts every type I've tried!
That's J-M CUMPAC® 236- it's specially designed to withstand high temperatures and pressures

Now available at your local Johns-Manville Packing Distributor

saves time and trouble . . . reduces expensive soot blower repacking

YOU MAY HAVE ALREADY discovered that traditional soot blower packings cannot withstand the higher temperatures and pressures employed in boiler operation today. Now, Johns-Manville brings you a new packing specially developed for this service. Cumpac 236 won't harden or vulcanize and greatly outlasts all other packings of the conventional types.

In plants where it has already been introduced, users report excellent results. Soot blower repacking has been reduced to a substantial degree.

How it is constructed: Cumpac 236 resists high temperatures and pressures because it is specially made of high purity asbestos yarn braided over a plastic core of special heat-resistant composition and lubricated with mica. This material is formed into a combination of lip type and solid packing which provides low friction contact with the soot blower tube and seals the entire stuffing box.

Your J-M Packing Distributor carries No. 236 Cumpac sets for all popular soot blowers. He also stocks other Johns-Manville Packings and Gaskets. Ask him for the Cumpac 236 folder, PK-100A, or write Johns-Manville, Box 60, N. Y. 16, N. Y. In Canada, Port Credit, Ontario.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville PACKINGS & GASKETS

More TECHNICAL BRIEFS

Begins on page 156

water heater. It is similar to about 100 heat-pump water heaters now in service, except that the solar collector is substituted for the forced-air refrigerant coil. *WSASE paper; no number.*

Cooling with solar energy. *By George Löf, Consulting Chemical Engr, Denver, Colo.*

One of the most intriguing potential applications of solar energy is in air conditioning or comfort cooling. Of the possible methods for using solar energy to produce cooling, two of the most promising have been studied.

Food refrigeration by solar energy has received very limited consideration, and further experiments are being made.

One of the big advantages of space cooling with solar energy is the availability of maximum solar radiation when cooling is most needed. This reduces or eliminates need for energy storage required in solar heating of homes. Furthermore, the system has a flexible capacity which minimizes peak design requirements.

Two feasible systems for direct cooling by means of solar energy are absorption refrigeration and absorption dehumidification. But unless a solar unit is also used for winter fuel saving, solar comfort cooling by either refrigeration or dehumidification cannot compete with conventional compression-refrigeration cooling in the U.S. This is because the additional investment in the solar collector more than offsets summer energy savings. *WSASE paper; no number.*

Solar machines. *By Nathan Robinson, Israel Institute of Technology, Haifa.*

This paper contains a survey of solar machines, their principles of operation, limitations and relative performance, compared with other types of heat engines. It is extremely interesting and should provide a good background for anyone interested in the historical development of solar energy application.

A solar machine for motive force must contain three parts: a collector for accumulation of solar energy and for raising temperature of the working liquid or gas, a storage device for the time of interruption of the sunshine, and a motor adapted to the energy level given by the first two devices.

The paper is divided into seven sections covering construction, operation and economics of collectors, solar furnaces, heat engines, storage problems, advisability of solar-energy use, solar stoves and stills. *WSASE paper; no number.*

Mechanical energy from solar energy. *By R C Jordan and W E Ibele, University of Minnesota.*

For more than a century, numerous inventors have been fascinated by potentialities of solar power. Many have attempted to develop solar-mechanical power-conversion systems. Some of these units have been more sensational than practical. No fully developed system has to date shown economic feasibility.

This paper discusses a number of factors influencing application of solar energy, including fuel supplies, heat-engine cycles, efficiency and a number of devices previously used to harness solar energy.

The authors feel that the best hope for solar energy in the immediate future is for small power systems with storage in remote areas, systems where intermittent operation is not a deterrent, and limited, specialized use in the field of astronautics for power generation on artificial satellites. *WSASE paper; no number.*

Algae as an energy converter. *By Jack Myers, University of Texas. WSASE paper; no number.*

Prospects for utilizing solar energy and certain practical experiments of the Heliolaboratory of the G M Krzhizhanovsky Power Institute of the USSRR Academy of Sciences. *By Prof V A Baum, USSR Academy of Sciences, Moscow. WSASE paper; no number.*

Direct conversion of solar energy. *By P M Erlandson, Southwest Research Institute. WSASE paper; no number.*

Steam power

Design features, operating experience and performance of 100,000-kw reheat installation at Potomac River tation. *By L W Cadwallader, Potomac Electric Power Co and H S Frederick, Stone & Webster Engineering Corp.*

This paper discusses outstanding design features, operating experience, manpower requirements and performance record of a generating unit with a design capability of 100,000 kw and with steam conditions of 1800-psig, 1050-F primary steam temperature and 1000-F reheat steam temperature. Design capability of 100,000 kw is somewhat less than the national average of 124,000 kw for all reheat machines purchased in the last six years.

Initial steam pressure and temperature have been surpassed by other installations, and condenser circulating-water temperature is relatively high, with a maximum of 88 F and a four-month average of 81 F for June to September, inclusive. Notwithstanding these basic limitations, the over-all thermal efficiency is averaging 37%, which is near optimum for conditions below the supercritical.

Unit under discussion is No. 3 in a station also housing two 90,000-kw non-reheat machines placed in operation in October, 1949 and June, 1950. The new No. 3 unit was placed in preliminary operation June 30, 1954, and became firm commercial capacity two weeks later. Unit No. 4, which is a duplicate of No. 3, is under construction and is scheduled for service early in 1956. There is a single boiler per turbine and the fuel used is pulverized coal. Light fuel oil is used for ignition. *ASME paper No. 55-S-21.*

An approach to the economic problem of matching condenser surface with exhaust-annulus area. *By Professor W A Wilson, Massachusetts Institute of Technology and 2nd Lt L G Malouf, USAF.*

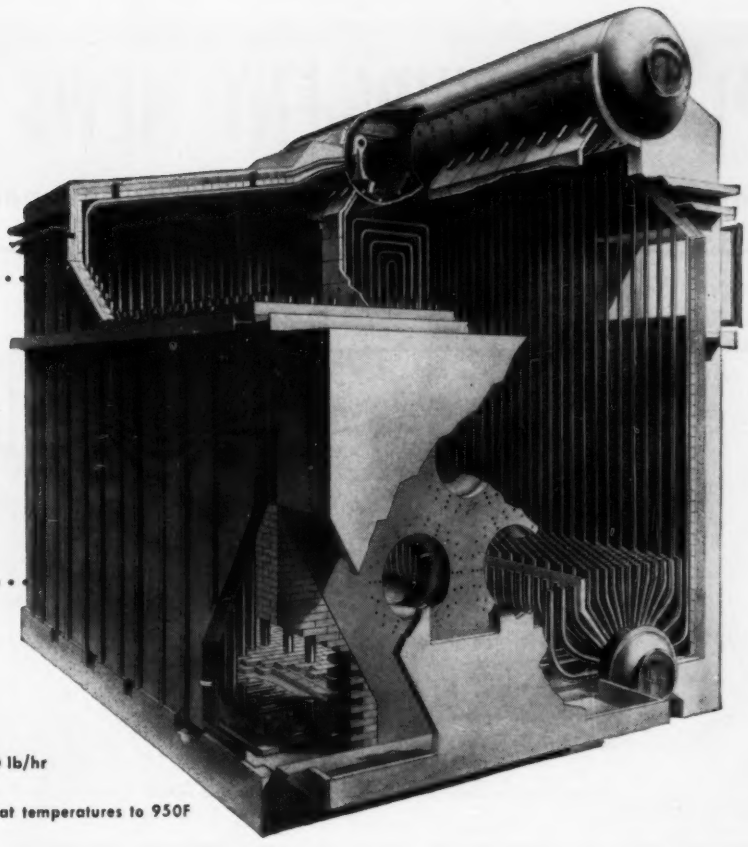
Purpose of this paper is to present a method of analysis whereby separate tasks of selecting appropriate condensing surface and appropriate turbine-exhaust annulus area for a given power-plant application are reduced to the single problem of selecting a *balanced* combination of these areas. This simplification is possible because effects of each of these areas on operating cost and on plant capacity are made manifest by their influences on the same working fluid property; i.e., the stagnation enthalpy leaving the last turbine blade row.

At the same time, remaining components of the plant are sensitive only to this enthalpy and not to variations of the combination of condensing and exhaust-annulus areas which establishes that enthalpy. This means that if the stagnation enthalpy is assigned a value, corresponding economically appropriate condenser-annulus combination is the one that produces the enthalpy for the least capital investment. This combination is balanced for the

(*Continued on page 226*)

Directions for ordering papers on page 232

Series "SC" STANDARD Steam Generator



FUELS: Oil or Gas
CAPACITIES: 50,000 to 150,000 lb/hr
STEAM PRESSURES: to 1500 psi
STEAM TEMPERATURES: Superheat temperatures to 950F

PRE-ENGINEERED FOR SAVINGS

in first cost, installation, operation, maintenance

Series "SC" Steam Generator is of the pre-engineered, standardized design, with all exterior and structural details fixed. Available in nine sizes, with capacities of 50,000 to 150,000 lbs steam per hr, it incorporates many advanced design features — as noted in the accompanying list — that make possible important savings in industrial steam costs.

Burners, controls, upper drum mountings and other equipment requiring attention are located at the front of the unit. Heat recovery equipment and fans can be placed near the operating aisle for either single or multi-unit installations, providing unusual accessibility and ease of operation.

Write us today for further information on how the Series "SC" Standard Steam Generator can meet your individual plant needs for power or process work. *Foster Wheeler Corporation, 165 Broadway, New York 6, New York.*

FEATURES AT A GLANCE

- Completely water-cooled furnace
- Over 19-foot firing depth
- Unrestricted circulation
- All-welded casing
- Fully drainable superheater
- Efficient convection surface
- Bottom supported unit
- Steam purifying system
- Full insulation

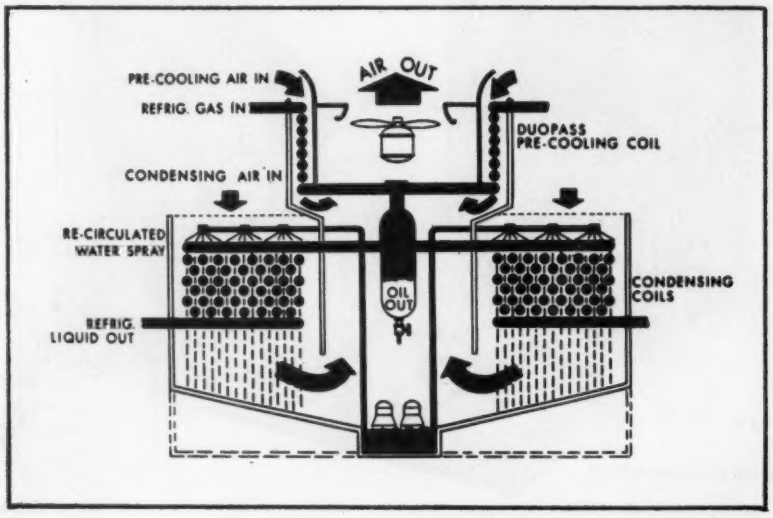
FOSTER WHEELER

NEW YORK • LONDON • PARIS • ST. CATHARINES, ONT.

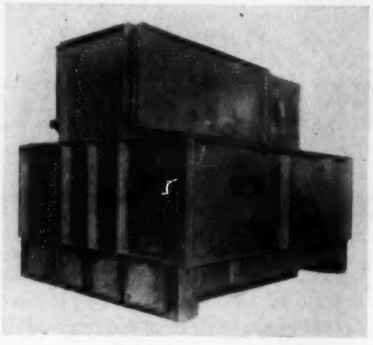
PLANT EQUIPMENT NEWS

Your information center for new products designed to solve plant problems

Published monthly as a service to readers



Evaporative condenser for ammonia refrigerant will handle to 240 tons



105 • Refrigerant in these units is condensed in two parallel mounted coils enclosing a central plenum under the fan section. Water sprays are arranged over the coils and air enters from above, travels downward and changes direction to enter the plenum, at which point the entrained water is eliminated. The air then moves up and out through propeller fans.

Hot gas is sub-cooled before condensation by first passing through duo-pass pre-cooling coils mounted beside the fan section. A dry air stream crosses this coil, removing the super-heat. Any oil vapor present is liquefied during this process and removed by a separator in the gas line ahead of the condensing coils. The only water consumed is that evaporated. Unrestricted down-draft air instantly removes excess water from condensing coils—improves heat transfer from refrigerant gas to air stream. Excess water is recirculated.

All sections of the condenser are encased in separately removable panels —allowing complete accessibility for maintenance. Removing a single panel gives entrance to the central plenum and puts all interior parts within reach. Unit is available in four sizes: 90, 120, 180 and 240 tons. Ratings are for ammonia, although the condensers are also applicable to freon. Dimensions of the largest size are approximately 13-ft long, 16-ft wide and 10½-ft high.

Niagara Blower Co, 405 Lexington Ave, New York 17, N. Y.

Portable hand pump

108 • Unit is designed for refilling all types of oil cups and reservoirs directly from a gallon or larger container through a light flexible hose. Also used for dispensing oil to bearings, cutting tools, conveyor and drive chains, gears, pipe-threading operations, etc. Unit can dispense oil in any direction or angle. No air lines are needed. Request bulletin 44 from manufacturer for details.

Trico Fuse Mfg Co, 2948 N 5th St, Milwaukee 12, Wis.

Non-corrosive coagulant

106 • *Nalco 600*—a polyelectrolyte —shows most promise in coagulating turbid river and surface waters, according to manufacturer. It is said to effect excellent coagulation in many cases where presently available treatments are ineffective and where iron and alumina floc carryover is a problem.

It is recommended for waste-water treatment as well as for paper mill treatment of water for general service and for settling in savealls. The clear, liquid, alkaline coagulant is non-corrosive to steel—has proved useful in lime-soda plants and processes, manufacturer states.

National Aluminate Corp, 6216 W 66th Pl, Chicago, Ill.

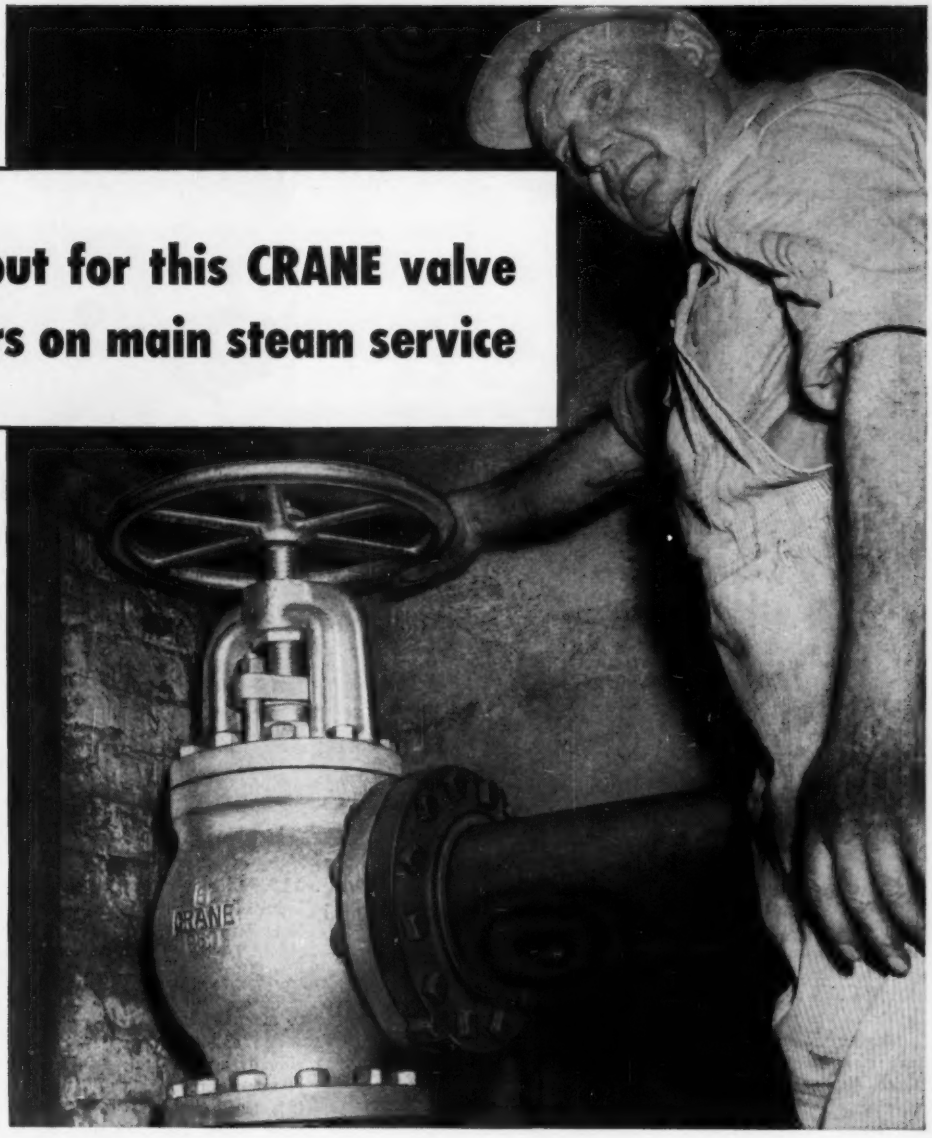
Heavy-duty flashlight

107 • Industrial flashlight is made of chemically-resistant nylon — resists extremes of heat, cold and rough handling. It is unaffected by all common organic solvents and compounds containing gasoline, oil, grease, paint remover, lacquer, carbon tetrachloride, alkaline cleaners. There are no exposed metal parts. Claimed features include a removable end cap with ring holder molded of nylon and a lacquered, aluminized reflector. Available in either two or three cell models.

Ray-O-Vac Co, 212 E Washington Ave, Madison, Wisconsin

For more data on these items, use post cards page 169. Identify your request with item number.

No time out for this CRANE valve in 40 years on main steam service



THE CASE HISTORY—Two Crane 250-pound iron body angle valves—6-inch (shown) and 5-inch size—scored this exceptional service record.

They were installed in 1915 on the main steam leads from boilers in the plant at Delavan, Wis., now occupied by The George W. Borg Corporation. In 40 years' uninterrupted service these Crane valves never failed to operate properly nor caused a shutdown. With but routine maintenance, they opened fully and were seated tight with ease under infrequent operation. Working pressure of boilers was originally 150 psi.—later reduced to 75 psi. This year, both valves were retired. The new replacements are Crane quality valves, of course.

Crane iron valves in particular need no introduction to thrifty buyers. In all grades, Crane iron castings generously exceed the requirements of equivalent A.S.T.M. specifications. Crane Ferrosteel, for instance, used in 250-pound valves is 35% stronger than ordinary cast iron.

In any pressure class, you'll find Crane quality outstanding. Choose from complete lines of gates, globes, angles and checks.

Your Crane Representative can give valuable help in specifying and ordering.

CRANE VALVES & FITTINGS

PIPE • KITCHENS • PLUMBING • HEATING

Since 1855—Crane Co., General Offices: Chicago 5, Ill. Branches and Wholesalers Serving All Areas

More EQUIPMENT NEWS

Begins on page 160

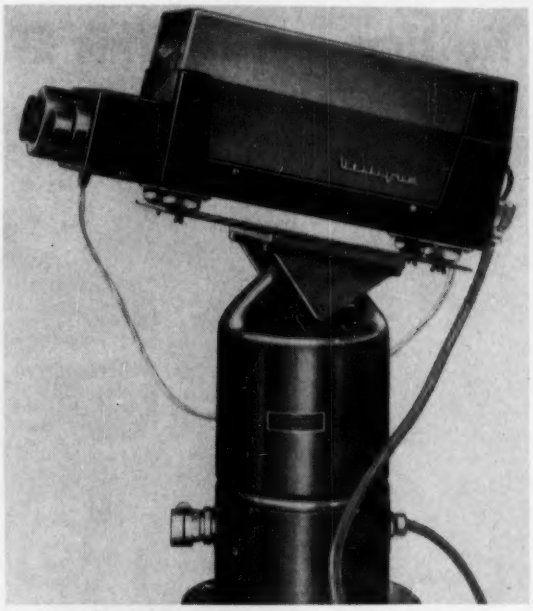
Two remote-control systems for today's industrial television

System provides complete operator safety

111 • Remote-control closed-circuit TV system provides operator safety in hazardous locations, assures undetected operation in security and surveillance work and permits quick viewing of widely spaced objectives, manufacturer states.

System includes a multi-lens TV camera that is entirely directed by a separate monitor-console. By turning appropriate knobs on the console camera lenses are changed, focusing is set, camera is directed—all by remote control. Console controls also make it possible to automatically point the camera in three different pre-set directions. This facilitates repeated viewing of more than one area or operation.

Dage Television Div, Thompson Products, Inc, Michigan City, Indiana



Unit is designed for wide area coverage

112 • Remote-control pan and tilt mount may be used on any industrial TV camera, on both outdoor and indoor installations. Rotation is full 360 deg or it can be limited to any arc desired. Tilt is 45 deg above horizontal and 45 deg below—90 deg in all. Complete 360 deg rotation is accomplished in 36 seconds while 90 deg tilt requires but 15 seconds, according to manufacturer's statement.

Pan and tilt motions are driven by separate motors individually and remotely controlled from a control panel located at any desired point. The mount is especially useful where it is necessary to have one camera cover a wide area, manufacturer states. Complete data available on request to company.

Diamond Power Specialty Corp, Lancaster, Ohio

For more data on these items, use post cards page 169. Identify your request with item number.

Quadra-type threader

113 • Quick-opening pipe threader is designed for use with any power drive. It threads 1, 1¼, 1½ and 2 inches with only one set of full-width high-speed dies—which is the same length as a perfect standard thread in the 1 to 2-inch range.

There is no lead screw to jam or reset. User is able to set and reset dies instantly, according to manufacturer. New guide design is said to give instant and perfect alignment without clamping to the work.

Unit has a quick-opening die throw-out. When throw-out is opened, the dies retract. There is no need to back off over finished threads.

Beaver Pipe Tools, Inc, Warren, Ohio

Packaged boiler line

114 • Scotch-type units, in sizes from 12 to 125 hp, are available for gas or oil firing, or combined fuels, for every process heating requirement.

When electricity, steam, water and fuel lines are hooked up, boiler is ready to produce steam. Burner equipment is controlled automatically.

Features claimed include (1) large steam space combined with larger water storage to give greater reserve capacity which ends fluctuation in steam pressure and meets peak loads, and (2) larger internal furnace with 300% greater combustion volume to permit high heat output without strain or danger of heat cracks. Further details on request.

Eclipse Fuel Engineering Co, Rockford, Illinois

New-type piston

115 • Manufacturer asserts that this piston ends the problem of "head burning" in diesel engines using direct injection of fuel. Unit incorporates a button or "hot-spot" of niresist in the piston's crown that is molecularly bonded to the aluminum body of the piston. Having a much higher melting point than the aluminum, it does not erode under heat as does the aluminum.

Manufacturer points out that iron buttons have been used for this purpose, but have been bonded mechanically and in time, due to difference in expansion rates of the two materials under heat, have loosened. Molecular bonding is said to overcome this.

United Engine & Machine Co, San Leandro, California

higher loads...
economy fuels...
new
engine designs...

there's one answer for all three of these lubrication problems—

Demands upon the lubricant in stationary industrial engines are increasing. More severe operating conditions caused by heavier loads, new engine designs and the use of economy fuels pose difficult lubrication problems not met by conventional oils. Standard Oil Company introduces a lubricant specifically designed to meet these problems—STANODIESEL Oil M.

STANODIESEL OIL M

STANODIESEL Oil M meets or exceeds the requirements of a lubricant for stationary industrial engines. Here's why:

STANODIESEL Oil M is refined from the highest quality base stock. It has superior stability.

Special additives are blended with this STANODIESEL Oil M base stock. An oxidation inhibitor prevents unwanted increases in oil viscosity and prevents corrosion of bearings. The action of detergent-dispersant additives keeps crankcase, pistons, cylinder walls and other parts clean. Contaminants are kept in suspension and are prevented from depositing. An anti-foam agent makes this oil suitable for use in hydraulic governors. A wetting agent increases the oil's ability to reach and maintain a film on such highly stressed parts as cams and cam followers.

Use of STANODIESEL Oil M means this: less engine deposits, less ring and cylinder wear. Less spark plug fouling when used in gas engines. Eliminates fuel injector and pump sticking caused by deposits on the injector barrel and plunger when fuel and lubricating oil commingle.

You need to know about STANODIESEL Oil M. In the Midwest, call your nearby Standard Oil lubrication specialist. You will receive the information promptly. Or write Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

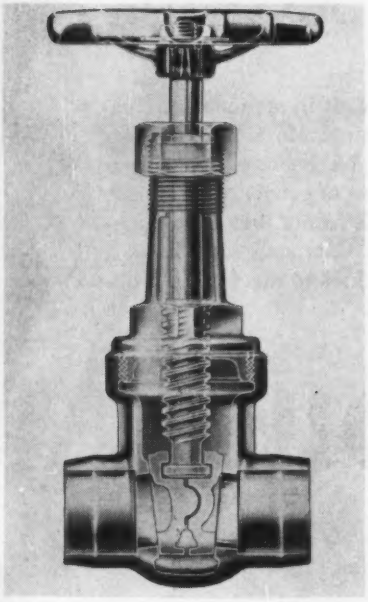
STANDARD

STANDARD OIL COMPANY (Indiana)

More EQUIPMENT NEWS

Begins on page 160

Check these 5 items for possible answers to your valve problems

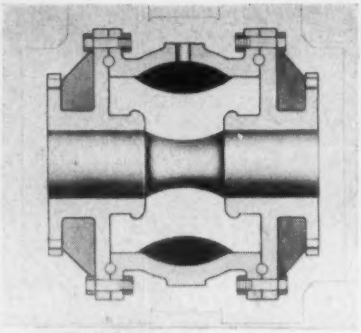


Bronze solder-end valves

100 • Line of five bronze solder-end valves includes three gate valves, a swing check valve with renewable disk and side plugs, and a non-metallic-disk globe valve. The three gate valves—rising stem with double-wedge disk, rising stem with solid-wedge disk, and non-rising stem with single-wedge disk—and the check valve are all rated at 125 lb steam pressure and 200 lb water, oil or gas. The globe valve is rated at 150 lb steam and 300 lb water, oil or gas.

Each is designed with plain ends for use with types K, L and M copper tubing. Connections are made by a simple soldering operation and the installation assures full flow and compact assembly, according to manufacturer. Recommended uses include service on plumbing, heating and air-conditioning lines; low-pressure steam service; underground water lines; condensate return lines; liquor lines in breweries and distilleries; dye lines in textile mills, bleacheries. For further details request bulletin from manufacturer.

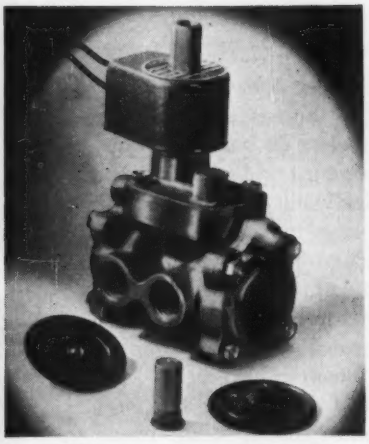
Lunkenheimer Company, Box 360, Cincinnati 14, Ohio



Rubber slurry valves

101 • Stressing better control for abrasive and corrosive flows, these valves are encased and rupture-proof, have center orifice flow and simple remote finger-tip control, according to manufacturer. Massive moulded-rubber section is said to assure maximum resistance to abrasion. Further information in bulletin 55, available on request to the manufacturer.

Equipment Engineers Inc, San Francisco 4, Calif.



Packless 3-way solenoid valve

102 • Unit has just three moving parts —two diaphragms and one stainless-steel core. Rated for 250 psi on liquids and gases, manufacturer states that it will operate under severest conditions at up to 400 cycles per minute. The valve may be converted from normally-closed to normally-open operation (or vice versa) by loosening two bolts and rotating bonnet 180 degrees —without removing it from pipeline.

Unit mounts in any position, is available in ⅜ or ½ in. pipe connections. For full data request bulletin 8316.

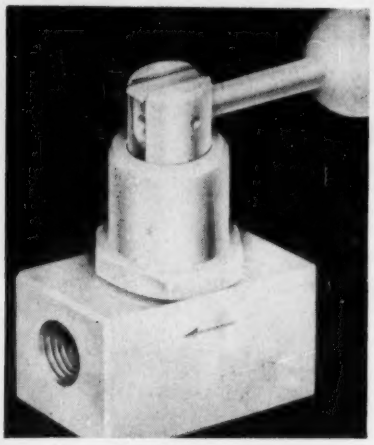
Automatic Switch Company, 391 Lakeside Ave, Orange, N. J.

Pilot-operated solenoid valve

103 • Unit has no metal-to-metal contacts. Synthetic diaphragm "floats" free, providing greater fluid flow at lower pressure differentials, manufacturer states. It is usable for control of water, air, brine, light oils, industrial gas, Freon 12 and 22, and other non-corrosive fluids at temperatures from 0 to 225 F.

Available with or without manual operator that opens auxiliary pilot port within the valve and allows system's pressure to actuate diaphragm in a normal manner in event of electrical failure.

Jackes-Evans Manufacturing Co, 4427 Geraldine Ave, St. Louis, Mo.



Manual shut-off valve

104 • Toggle-operated unit is rated at 0 to 3000 psi—can be used in either hydraulic or pneumatic service. Manufacturer states that perfect sealing is achieved by use of resilient O-ring, protected from the fluid stream by a floating-sleeve arrangement. This O-ring is not required to pass a port or other diametral relief or construction that might damage its surface. Typical applications are as block valves in pilot plants, instrument systems, or as a shut-off for sources of various liquids, gases, and similar uses. Further details on request.

James-Pond-Clark Co, 2181 E Foothill Blvd, Pasadena 8, Calif.

For more data on these items, use post cards page 169. Identify your request with item number.

▲ Surface condenser, 60,000 sq. ft., using Revere Muntz Metal Plates weighing 23,518 lbs.

Two oil coolers, also using Revere Muntz Metal Plates. The four plates weigh 1,995 lbs. ➔

LARGE PLATES FOR CONDENSERS

. . . SMALL FOR OIL COOLERS

REVERE SUPPLIES THEM BOTH!

These two pictures offer a great contrast in the size of the equipment. The large condenser has 60,000 square feet of surface, the small oil coolers only 1,100 square feet. Both were made by Westinghouse Electric Corporation, Steam Division, Philadelphia, Pa., for the Columbus & Southern Ohio Electric Co., Columbus, Ohio. Revere supplied 23,518 lbs. of Muntz Metal plates for the condenser. There are four plates, 113½″ x 153″ x 1¼″ thick, hot rolled and leveled, cut to pattern. The oil coolers required four Muntz Metal circles, weighing 1,995 lbs. Two are 35¼″ in diameter and 1¾″ thick, and two are 31¾″ in diameter by 2″ thick. The units are for the utility's Picway generating station, for use with a 100,000 kw. turbo-generator.

Revere supplies condenser and heat exchanger plates and tubes in all the usual alloys, including not only Muntz Metal, but Admiralty Metal, Aluminum, Bronze and Brass, and Cupro-Nickel. The latter is especially advisable for difficult water conditions, such as salt, brackish or heavily contaminated water. Selection of the correct alloy to meet actual operating conditions may at times be a problem. Consult Revere. We will be glad to collaborate on such matters, and recommend the alloy most likely to serve long and economically. See the nearest Revere Sales Office.

FREE. Send for your copy of the informative booklet, "Life Extension for Condenser Tubes." Contains much basic technical as well as practical information for designers and plant operators.

REVERE

COPPER AND BRASS INCORPORATED

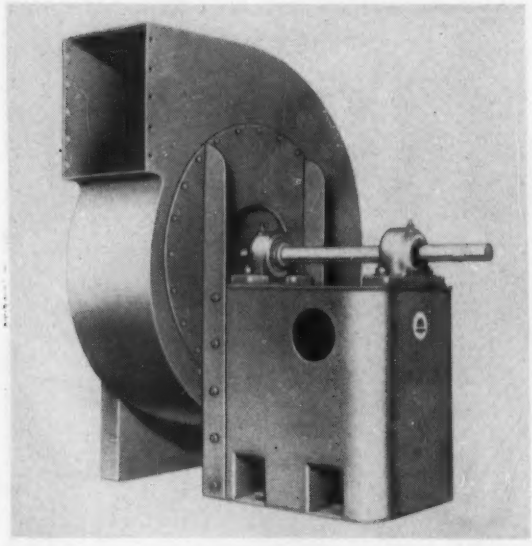
Founded by Paul Revere in 1801

230 Park Avenue, New York 17, N. Y.

• • •

Mills: Baltimore, Md.; Brooklyn, N. Y.; Chicago, Clinton and Joliet, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Newport, Ark.; Rome, N. Y. Sales Offices in Principal Cities, Distributors Everywhere.

Two streamlined fan designs for heavy industrial requirements



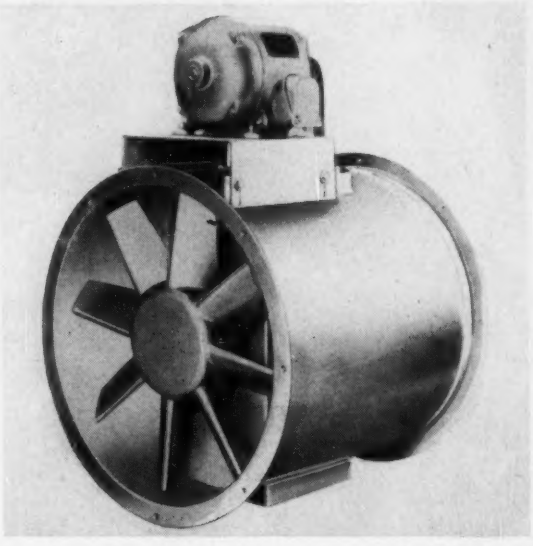
New line features a packaged industrial fan

109 • Manufacturer states that new line provides complete coverage of full range of industrial needs and features a packaged industrial fan complete with motor, V-belt drive and running-gear enclosure.

Designated *Series 106*, standard industrial fans, photo, in sizes 11 through 37 are available for volumes to 47,000 cfm operating with static pressures to 18 in. These adjustable discharge sizes permit a choice of three types of wheels: air-handling, material-handling and long-shavings. In sizes 41 through 60 the units are available with fixed discharge and handle volumes to 125,000 cfm at static pressures to 18 in. They can be obtained with either air-handling or material-handling wheels.

The packaged industrial fans are completely self-contained units designed for volumes to 23,000 cfm at static pressures to 10 in. They are available in sizes 11 through 26 with adjustable discharge housings. Material-handling wheels only are standard but air-handling and long-shaving wheels may be furnished on special order. Motor, V-belt drive, shaft and bearings of these units are mounted in a heavy-steel ventilated enclosure, one end of which is welded to the drive side plate supporting the housing shell. Outside end panel is removable for easy access to the interior. The driving motor is mounted on a universal support designed to carry standard NEMA motors. It is adjustable for belt tension. Prime advantages of the packaged unit is the elimination of need for a separate motor foundation and the minimizing of floor area required. Further data on request to manufacturer.

American Blower Corp, Detroit 32, Michigan



Eight fan models meet all ventilating needs

110 • Heavy-duty fans incorporate two aerodynamic design features: (1) Streamline contours are given all surfaces that contact air stream. Hub design is contoured and formed to approximate motor diameters and varies from 25 to 70% from the wheel diameters. This feature is claimed to eliminate turbulence over motor and back flow. (2) Aerodynamic blade design is said to produce an even distribution of air velocity from hub to tip, without "dead" spots. Blade angles, large at the hub, decrease to small values at the tip. Blades are wider than other standard designs, manufacturer states.

Wheels of 2, 4, 6 and 8 blades are available for various pressure and volume requirements.

Eight models are being manufactured, including fans with direct and V-belt drives. Fourteen different wheels from 12 to 72 in. diameter are made and, in all, 502 models are catalogued to meet every need. Wheels are available in alloys that are resistant to corrosion and high temperatures.

Automatic fan louvers are used in conjunction with wall-mounting installations to protect propeller fan and interior of building from rain and snow. All bearings are inside the frame—not exposed to weather. They can be furnished either automatic air operated, manual or motor operated.

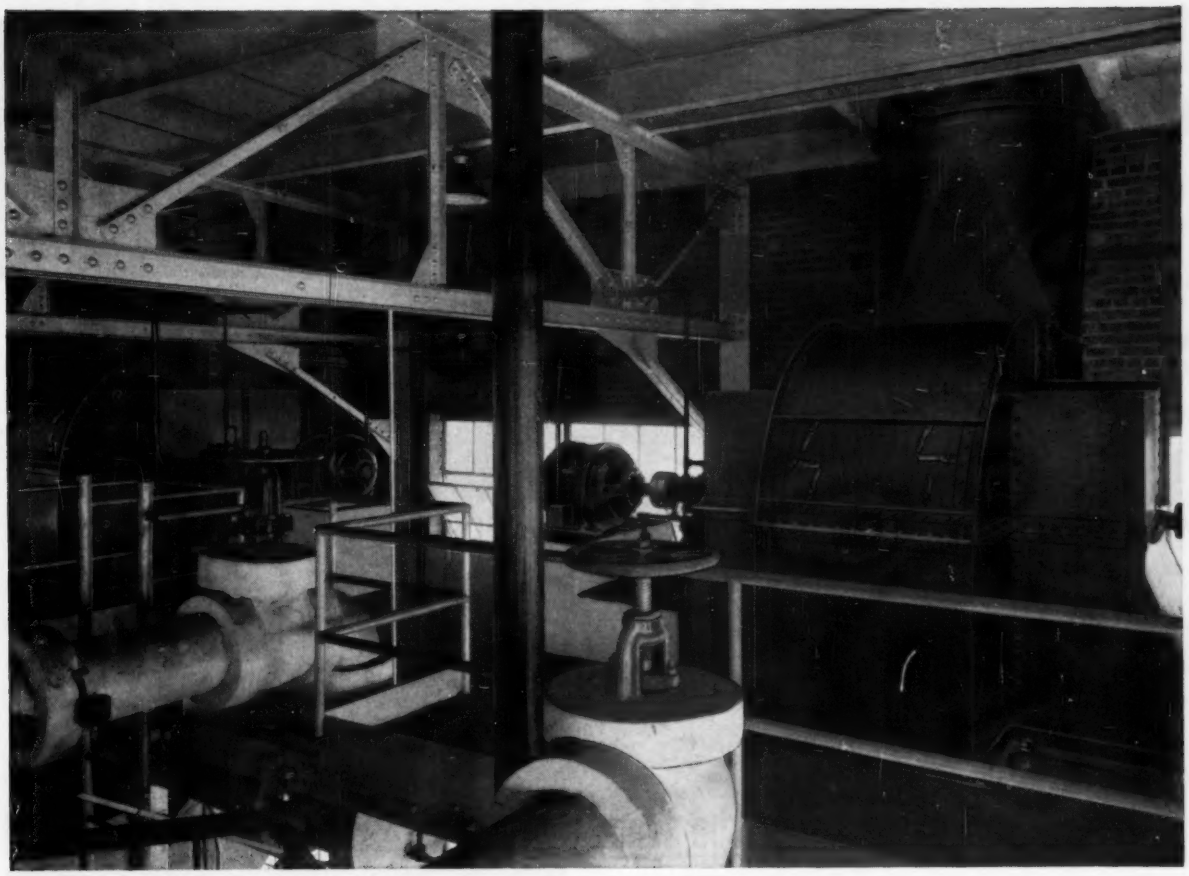
Units deliver from 1240 to 102,000 cfm at static pressures of ⅛ to 3½ in. Photo shows a belt-driven duct fan for corrosive atmospheres or extreme temperatures.

Chicago Blower Corp, 9869 Pacific Ave, Franklin Park, Illinois

For more data on these items, use post cards page 169. Identify your request with item number.

CHECK THESE TOO . . .

Water level gage . . . . . p 174
Two-hand clutch control . . . . . p 174
Steel orifice union . . . . . p 176
Submersible booster pump . . . p 178
Close-coupled pump motor . . . p 178
Explosion-proof panelboards . p 180
Portable electric plant . . . . . p 182
Controlled volume pump . . . . p 184
Aerosol, smoke photometer . . p 184
Sight flow indicator . . . . . p 186
Nuclear safety-control device . p 188



EVERY TON OF FUEL YOU BURN TAKES 12 TONS OF AIR

See P. 545 of FAN ENGINEERING, 5th Edition, chapter on Combustion and Mechanical Draft.

Since approximately twelve pounds of air must pass through your boilers to burn a pound of combustible, your draft department is no place to cut corners. Also, today's high pressure requirements for super-heated steam, plus air preheaters and flue gas cleaning equipment in the system, place extremely heavy loads on the fans. It calls for the best fans you can get!

This is why so many power plant operators use "Buffalo" Forced Draft, Induced Draft, Gas Recirculating, Primary Air Fans and Overfire Blowers. They're built with one thought: to deliver the draft your fuel requires, with the lowest possible maintenance costs, and the shortest and fewest possible draft timeouts. Have us mail you Bulletin 3750 and see why your best choice is "Buffalo".

**The "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.*

SPECIFY "Buffalo" THE DRAFT FANS with the "Q" Factors

- Built to stand up
- Easier to service
- High in efficiency
- Performance characteristics to meet pressure demands in modern steam generation practice

BUFFALO FORGE COMPANY

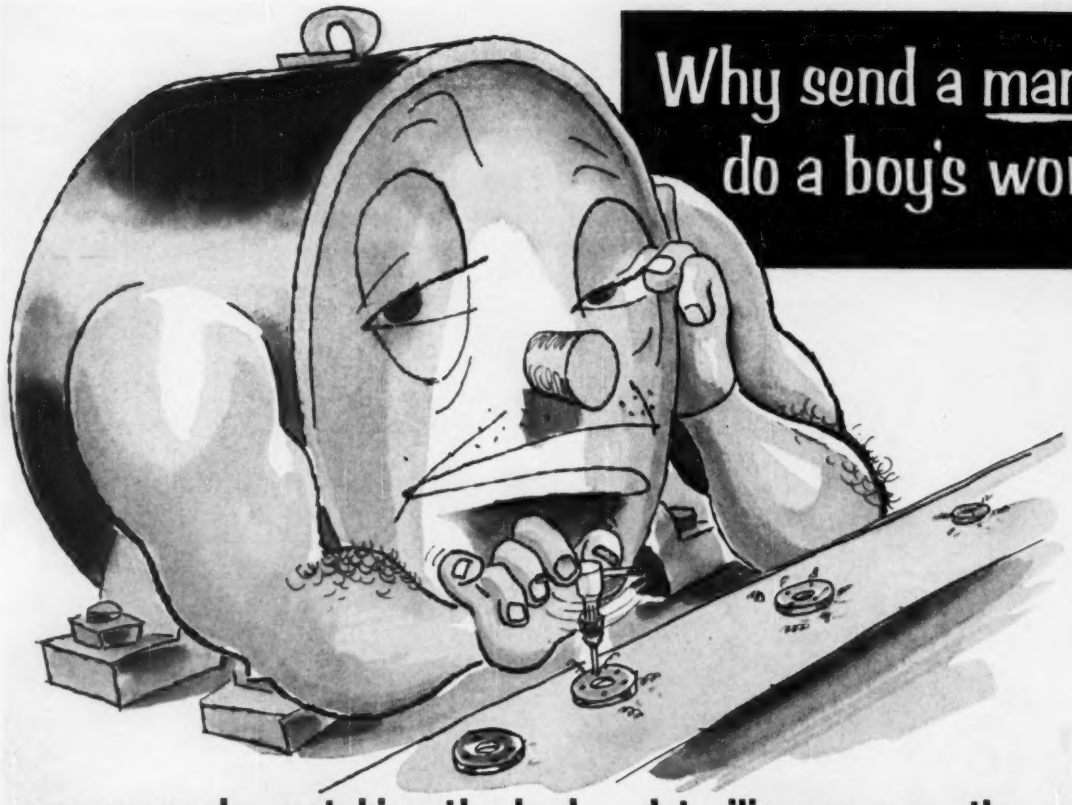
488 BROADWAY BUFFALO, NEW YORK

PUBLISHERS OF "FAN ENGINEERING" HANDBOOK

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

Sales Representatives in all Principal Cities

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING FORCED DRAFT COOLING HEATING PRESSURE BLOWING



Why send a man to do a boy's work?

save money by matching the load . . . let silicones carry the overload!

You get a service factor ranging up to 50% with Dow Corning Silicone insulated (Class H) motors compared to 15% for Class A.

This built-in service factor saves you the initial cost of installing oversized motors to withstand the heat generated in reversing service, for example. In many applications, it saves the cost of over-motoring to carry intermittent overloads, or loads that can't be matched in standard frame sizes.

And eliminating the need for over-motoring gives you a better power factor and higher efficiency, because the smaller silicone insulated motors come closer to operating at full load most of the time.

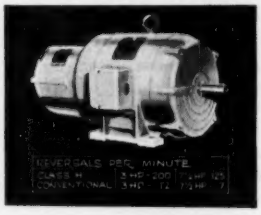
You also get more reliable service because motors insulated with Dow Corning silicones have superior resistance to heat, to a combination of heat and moisture, and to corrosive atmospheres.

Remember over-motoring is outmoded

to help you speed up production

LOUIS ALLIS

The Louis Allis Co. of Milwaukee has developed a line of rapid reversing motors which are silicone insulated and blower cooled to give a maximum number of reversals. A 3 hp Class H motor, for example, will do 200 idle reversals per minute compared to 12 for a conventional motor of the same frame size. A 7½ hp silicone insulated motor will do 125 idle reverals per minute compared to 7 for a conventional motor. These motors offer new production economies in any operation where high reversal capacity is required.



Dow Corning Corporation, Dept. 6901, Midland, Mich.

Please send me sources of supply for new Silicone (Class H) ☐ Motors ☐ Transformers

☐ Information on Louis Allis motors for rapid reversing service

NAME _____ TITLE _____

COMPANY _____

STREET _____

CITY _____ ZONE _____ STATE _____

DOW CORNING SILICONES

DOW CORNING CORPORATION
MIDLAND, MICHIGAN

ATLANTA • CHICAGO • CLEVELAND • DALLAS • DETROIT
LOS ANGELES • NEW YORK • WASHINGTON, D. C. (Silver Spring, Md.)

CANADA: Dow Corning Silicones Ltd., Toronto
GREAT BRITAIN: Midland Silicones Ltd., London
FRANCE: St. Gobain, Paris

Keep yourself up to date...

To get more info on new equipment or FREE copies of latest bulletins

follow these easy steps

Preceding pages tell you what's new in plant equipment. Each item is numbered. For more details on any item, write its number here

New free bulletins are listed and numbered, beginning on back of this page. To order those you want, write POWER item number here — *do not use manufacturer's bulletin number.*

Put 2¢ stamp on self-addressed card and mail it to us. We'll pass along your request to the various companies, they'll send the info

I want details on these New Products:

☐ ☐ ☐ ☐ ☐ ☐

Send me these FREE Bulletins:

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Please use before May 1, 1956. Void after this date. 1/56

My Name .....
Please print

Home Address .....

City & State .....

Title .....

Company .....

Power a McGraw-Hill Publication

I want details on these New Products:

☐ ☐ ☐ ☐ ☐ ☐

Send me these FREE Bulletins:

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Please use before May 1, 1956. Void after this date. 1/56

My Name .....
Please print

Home Address .....

City & State .....

Title .....

Company .....

Power a McGraw-Hill Publication

I want details on these New Products:

☐ ☐ ☐ ☐ ☐ ☐

Send me these FREE Bulletins:

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Please use before May 1, 1956. Void after this date. 1/56

My Name .....
Please print

Home Address .....

City & State .....

Title .....

Company .....

Power a McGraw-Hill Publication

This Month's FREE Literature

PLACE 2¢ STAMP HERE

Power
Reader Service Department
330 West 42nd Street
New York 36, N. Y.

PLACE 2¢ STAMP HERE

Power
Reader Service Department
330 West 42nd Street
New York 36, N. Y.

PLACE 2¢ STAMP HERE

Power
Reader Service Department
330 West 42nd Street
New York 36, N. Y.

AIR CONDITIONING, HEATING

1 **Spray-coil dehumidifiers.** Central-station-type units are described in 20-p illustrated bulletin 7827-H that features a 10-p section of application data. Also outlines design and construction features, optional arrangements and related equipment. American Blower Corp, Detroit 32, Mich.

2 **Air-recovery panels** for removal of odors and vaporous impurities from recirculated air in comfort-conditioning installations are subject of 4-p bulletin 106-D. Includes performance and selection charts. Connor Engineering Corp, Danbury, Conn.

3 **"Standard methods** of testing and rating forced-circulating air-cooling and air-heating coils" is subject of new Code published as bulletin 202. Included are test methods for steam and hot-water heating coils and chilled water and volatile refrigerant cooling coils. Heating and Cooling Coil Manufacturers' Assn, 2159 Guardian Bldg, Detroit 26, Mich.

BOILERS AND AUXILIARIES

4 **Steam generators** and custom metal fabrication is subject of 22-p bulletin 55-1. Photos, engr drawings of boilers ranging in capacities to 500,000 lb of steam per hr on standard fuels. The Wickes Boiler Co, 515 N Washington Ave, Saginaw, Mich.

5 **Packaged boilers,** sizes from 12 to 125 hp, are pictured and described in 8-p bulletin A-1041. Operating characteristics of gas, oil, and gas-oil burners are discussed along with application recommendations. Eclipse Fuel Engineering Co, Rockford, Ill.

COMPRESSORS AND ACCESSORIES

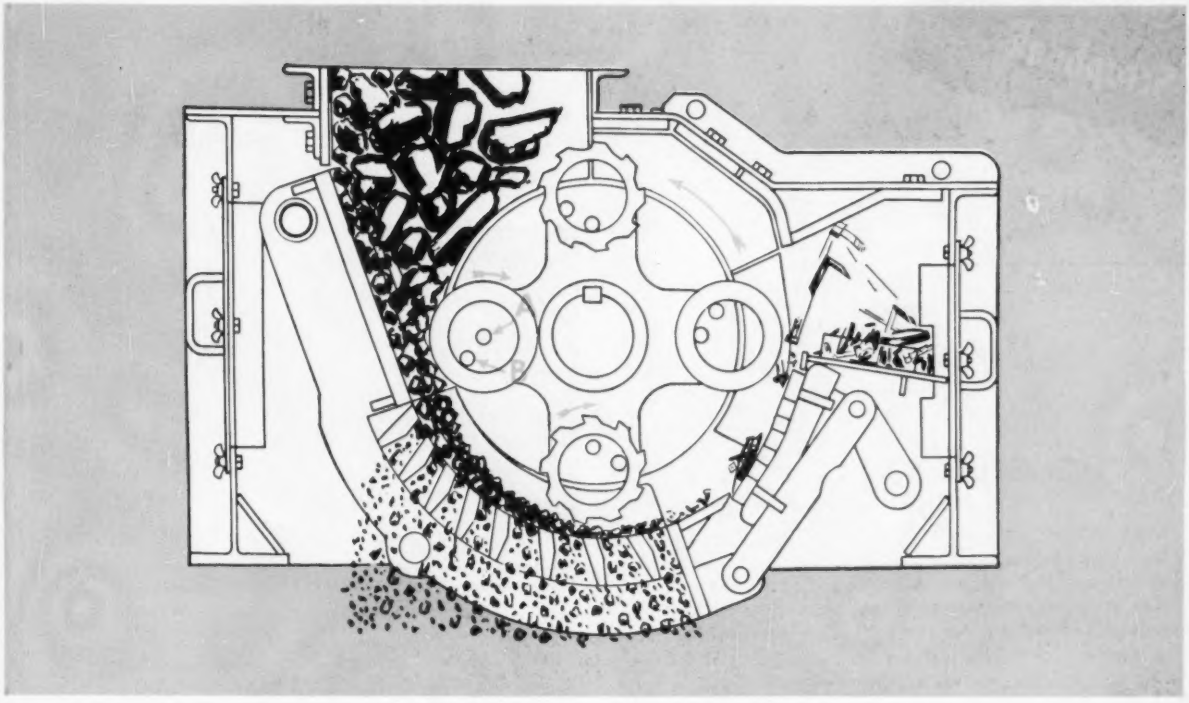
6 **Horizontal compressors.** Single-stage units from 50 to 2000 cfm and from 10 to 150 psi are detailed in 24-p bulletin L-640-BIC. Includes photos, specs, data on standard equipment, running gear parts, capacity control, cylinder construction, feather valves and special applications. Worthington Corp, Harrison, N. J.

7 **"Condensifilters** for instrument-quality compressed air" is title of 4-p bulletin M-7155. Contains a moisture-vapor content chart that enables evaluation of water vapor in a compressed air system. Hankison Corp, 269 Biltmore Bldg, 951 Banksville Rd, Pittsburgh 16, Pa.

ELECTRICAL EQUIPMENT

8 **Switchboards.** Illustrated 40-p bulletin GEA-4127B shows how eight classifications of standard switchboard are constructed, operated and tested. A discussion of basic circuit specs in duplex switchboards is included. General Electric Co, Schenectady 5, N. Y.

(Continued on page 214)



TWIN SUSPENSION BARS Give Operators Big Advantage In PENNSYLVANIA COAL GRANULATORS

Each row of Crushing Rings is hung on a *pair* of Suspension Shafts, "A" and "B". When running empty the rings are centrifugally balanced on shaft "A" but when they come in contact with the feed the rings are snubbed down against the coal by shaft "B" giving smooth positive crushing action. Conventional ring mills require increased speed of the rotor to hold the rings against the feed and at best the rings rock back and forth with a jerky crushing action, resulting in greater power requirement, increased wear and fines. Twin Suspension Bars and other exclusive improvements, such as the worm gear, link and lever Cage Adjustment, put Pennsylvania Coal Granulators far out ahead in ring hammermill design. Send for Bulletin #9003 that gives the complete story.

Pennsylvania has been designing and manufacturing crushers for over 50 years. Make use of the help our engineers can give you — they have over 100 cumulative years' experience.

patented exclusive feature

provides more positive

uniform crushing at slower speeds

... lower power requirements

... less overgrinding

PENNSYLVANIA

BRADFORD BREAKERS
HAMMERMILLS
IMPACTORS • JAWS
SINGLE ROLLS

PENNSYLVANIA CRUSHER DIVISION
Bath Iron Works Corporation • West Chester, Pa.

PE-200

George Edwards' Scrapbook

Get started today

"Every day you wait, you lose," says a friend. "All my life I have been planning and hoping and thinking and dreaming and loitering and waiting. All my life I have been getting ready to do something worth while. I have been waiting for summer, and waiting for the fall; I've been waiting for the winter, and waiting for the spring—waiting and dawdling and dreaming—until the day is almost spent."

Man enough to take blame?

Accepting the responsibility for his own mistakes is a must for every supervisor. Employes respect a boss who is man enough to admit he is wrong—makes them realize he is a human being same as his men.—*Glenn Gardiner*

You gotta keep moving

"In our country," said Alice, still panting a little, "you'd generally get to somewhere else—if you ran very fast for a long time as we've been doing."

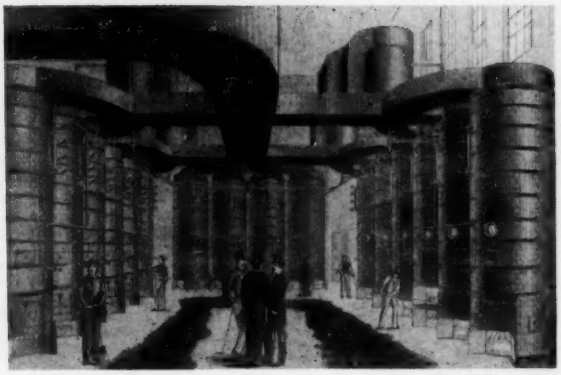
"A slow sort of country," said the Queen. "Now, here, you see, it takes all the running you can do to stay in the same place."—From *Through the Looking Glass*

Thoughts make leaders

A philosopher once said, "A man may plod along for years without showing any signs of accomplishment . . . when unexpectedly . . . something—a powerful thought—will seep into his mind . . . and a leader is born."

It ain't hay

Any way you measure it, the biggest thing about the power field is its future. Its immediate future shines brightly because business plans to spend $29 billion *this* year on new plants and equipment. They expect to repeat this sum next year—and the year after. And its *long-range* outlook is even brighter because our population is skyrocketing. Looks like our new industrial plants will need plenty of power.



Latest in boiler rooms: 1884

One way to size up the future is to look back at the past. This boiler room, for example, was modern in 1884. No doubt many people believed that these vertical, straight-tube boilers were as efficient as boilers would ever be. But today we know differently, for they were outdated a few years later. What some of us don't know, though, is that our present equipment will probably be just as outdated in the near future. Yet we're naturally as proud as these silk-toppered gentlemen were of their new plant.

If there's a lesson here, it's that the power picture is changing so rapidly that as the Queen says on this page, "It takes all the running you can do to stay in the same place." Which means that many of us are wasting good money with equipment installed a few years ago. It's not always easy to throw out machinery that's still in operating condition. But newer equipment will often amortize the original investment in a few years' time by saving in reduced fuel and maintenance bills.

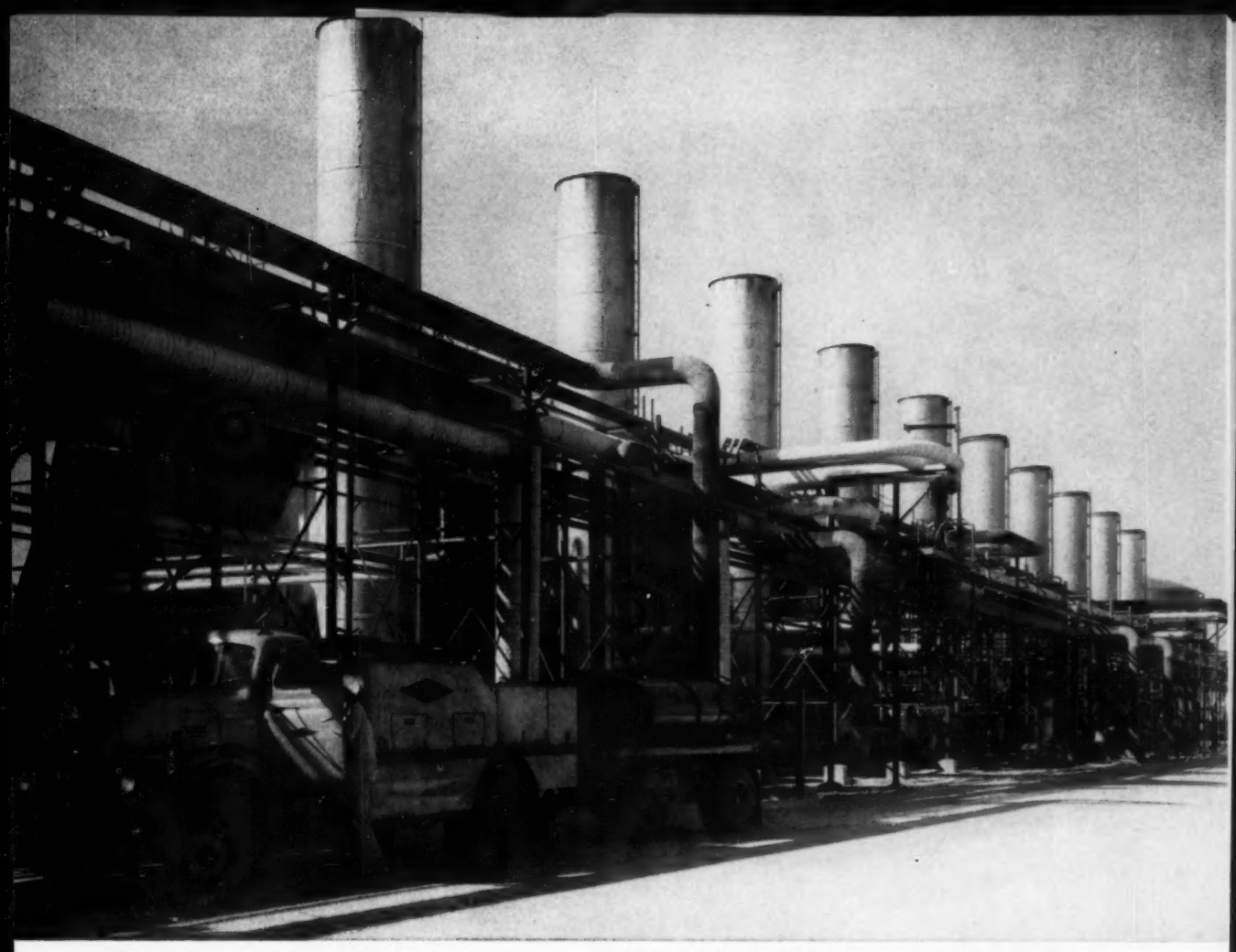
Wish all top management could see this photo. Then they would, I hope, call in a good consultant and give him the green light to shoot their plant full of holes. Some older plants are almost as ancient as one in above photo.

Want to live long?

Here is how 450 people lived to be 100. Why not try it?

1. They kept busy.
2. They used moderation in all things.
3. They ate lightly and simply.
4. They got a great deal of fun out of life.
5. They were early to bed and early up.
6. They were free from worry and fear, especially fear of death.
7. They had serene minds and faith in their creator.

George Edwards
Engineer



OPERATOR SAVED $440,000

DOWELL chemical cleaning of superheater avoided costly retubing and two-week boiler shutdown

Scale deposits had caused tube failures in the superheater of this 175,000-pound-per-hour boiler. To clean mechanically or replace the tubes would have required a two-week shutdown, costing $1,700 per hour in lost production. Instead, the operator chose Dowell chemical cleaning.

Experienced Dowell engineers developed special cleaning techniques for the nondrainable superheater, then used job-tailored Dowell solvents. The unit was restored to top operating condition in just 3½ days. Total saving to the operator, in cost of outage time and replacement parts, was approximately $440,000!

Dowell engineers hold downtime to a minimum by introducing solvents through regular connections. Extensive dismantling and scaffolding are not needed.

By removing corrosion products, chemical cleaning helps eliminate boiler tube failures due to overheating or galvanic attack. Prevent unscheduled shutdowns . . . keep your equipment operating at top efficiency . . . start a regular program of Dowell chemical cleaning *now*.

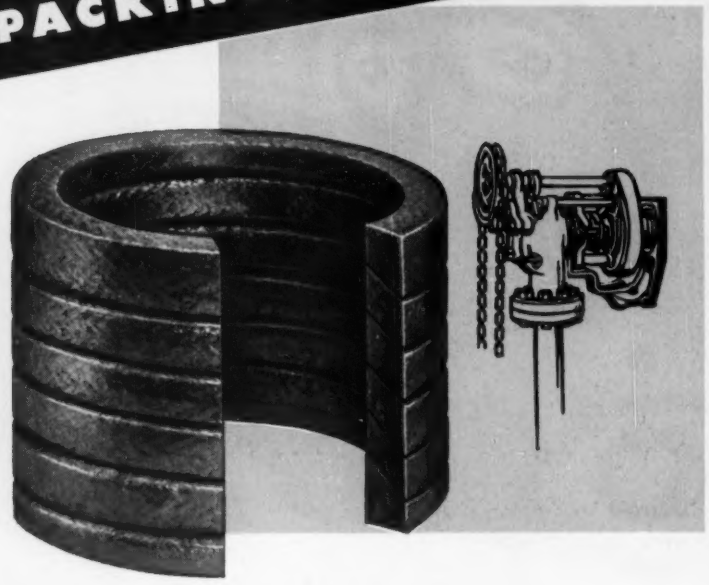
For more information, call any of the 165 Dowell offices in the United States and Canada. Or write directly to Dowell Incorporated, Tulsa 1, Oklahoma, Dept. A-23.

chemical cleaning service for industry

DOWELL

A SERVICE SUBSIDIARY OF THE DOW CHEMICAL COMPANY

Solved... A SOOT BLOWER PACKING PROBLEM



with the RIGHT combination of

"JOHN CRANE" PACKING

Problem: Leakage caused by packing vulcanizing and hardening where temperatures were over 400°F.

Solution: The *right* combination of "John Crane" packings . . . styles 177AM and 177J . . . offered maximum sealing ability, heat resistance and non-vulcanizing properties at elevated temperatures.

Results: Over six months of service, as compared to one or two weeks service from the rubberized fabric-type packing formerly used.

Field Engineers in our United States and Canadian Offices are trained to understand and solve your packing problems. They are always ready to assist you.

Write for full information on Styles 177AM and 177J Packings. Request catalog on "John Crane's" complete line of packings for all services.

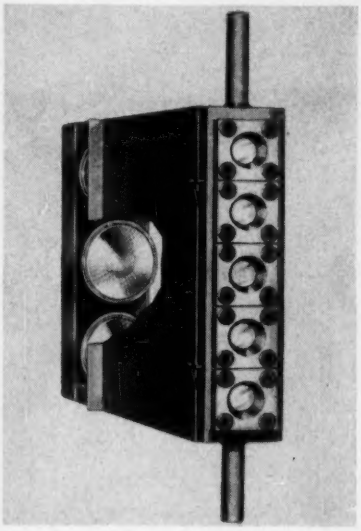
Crane Packing Co., 6430 Oakton St., Morton Grove, Ill., (Chicago Suburb).

In Canada: Crane Packing Co., Ltd., Hamilton, Ont.

JOHN CRANE CRANE PACKING COMPANY 38 YEARS INDUSTRIAL PROGRESS

More EQUIPMENT NEWS

Begins on page 160



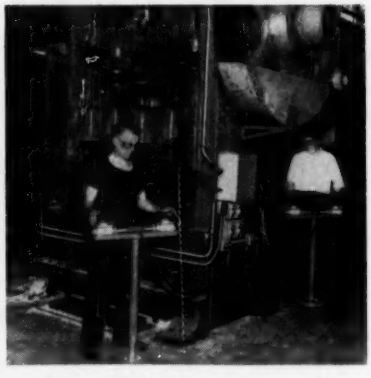
Water-level gage

129 • *Model MP-900* multi-port gage is recommended for pressures up to 900 psi; vision length is 12 in. Unit features five larger ports for maximum visibility. These ports are made possible by the lower-pressure operation that renders less severe design limitations. Unit is available with either end stems or flanged connections and is applicable to both existing and new boilers.

The bi-color gage shows water as green, steam as red. Water level is always where colors meet. Full details on request.

Diamond Power Specialty Corp, Lancaster, Ohio

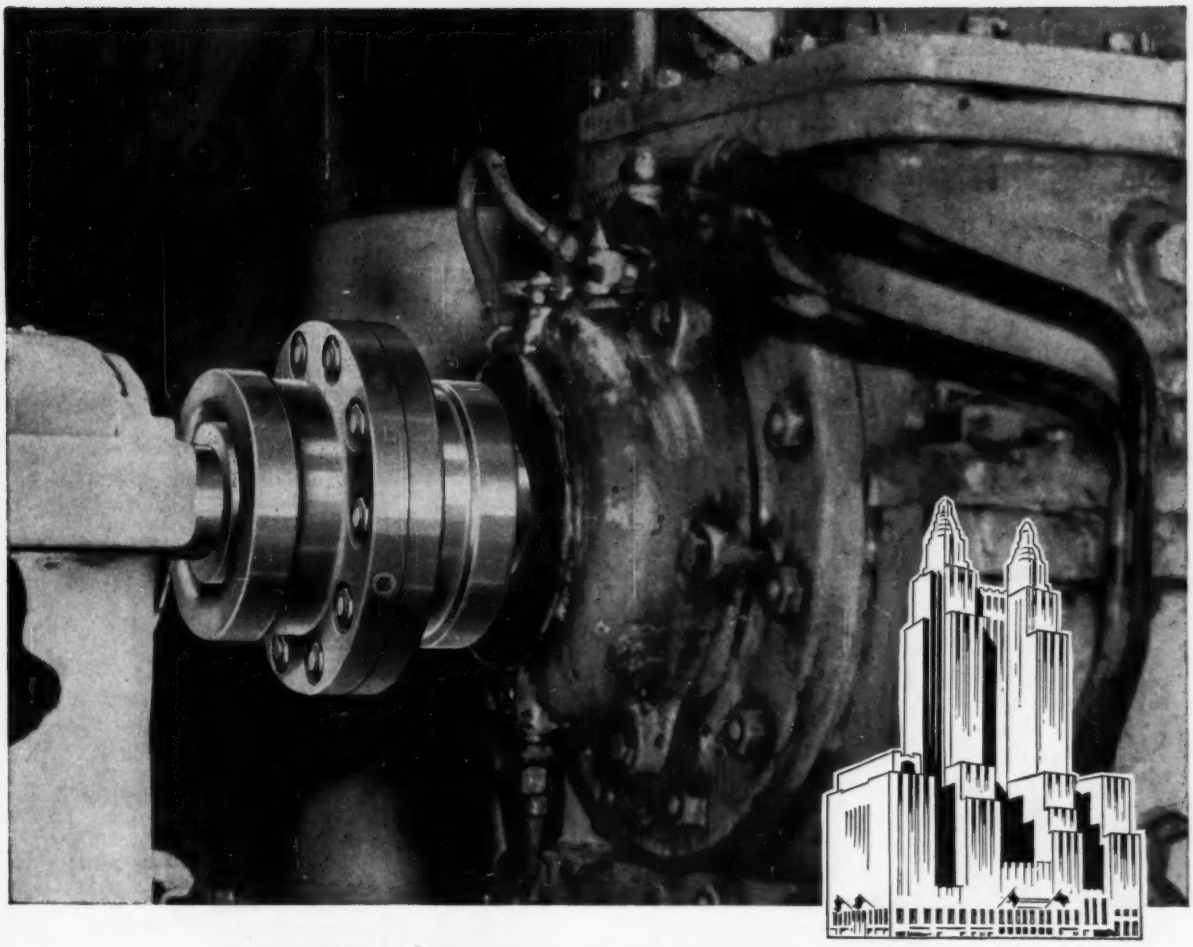
For more details on these items, use post cards p 169. Identify your request with item number.



Two-hand clutch control

133 • Improved electric two-hand clutch control for industrial machines is said to increase both production and operator safety.

Accidental operation of the clutch is impossible since clutch can operate only when control system is functioning properly. Two sets of contacts close on the actuator load on each operation and both must be released before next operation can be performed. A third set of contacts "breaks"



Fast's Couplings give Waldorf-Astoria 25 years of trouble-free service!

In 1930, Waldorf-Astoria management introduced air-conditioning in the hotel with the installation of a 240-ton centrifugal compressor. Five years later, two 350-ton compressors were added. All three machines were equipped with Fast's Couplings. To this date, those couplings have required no repairs of any kind.

For Fast's, the *original gear type* couplings, trouble-free performance is an old story. Because of their rugged all-steel construction and unique design, Fast's Couplings many times outlast the equipment they connect. This means you save on maintenance. You save on costly down-time. And throughout the years you can count on Fast's to provide reliable high torque transmission and protect your equipment against misalignment.

Over 35 years of coupling experience qualify Koppers' staff to give you the most effective and cost-saving solutions to *your* coupling problems. For free catalog, mail coupon below to: KOPPERS COMPANY, INC., Fast's Coupling Department, 221 Scott St., Baltimore 3, Maryland.

THE ORIGINAL **FAST'S Couplings**

KOPPERS

METAL PRODUCTS DIVISION • KOPPERS COMPANY, INC. • BALTIMORE, MD. This Koppers Division also supplies industry with American Hammered Industrial Piston and Sealing Rings, Koppers Electrostatic Precipitators, Aeromaster Fans and Gas Apparatus. *Engineered* Products Sold with *Service*

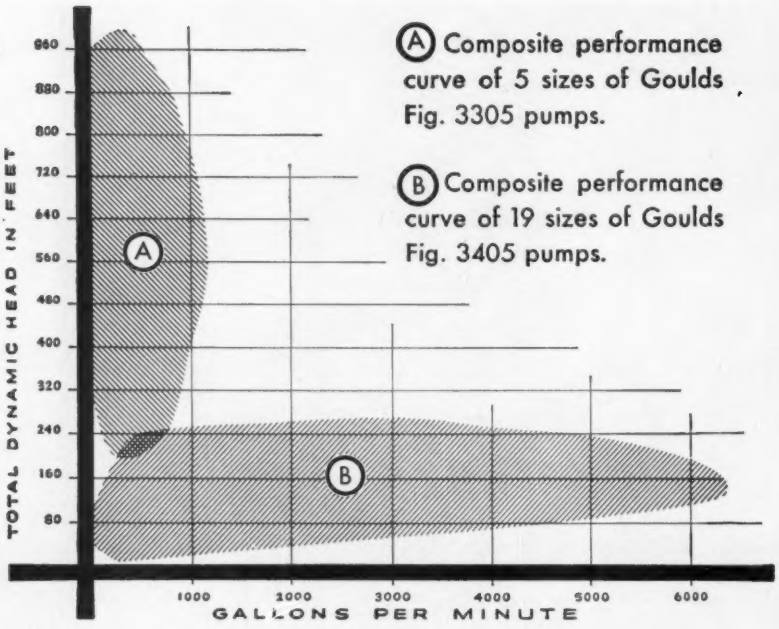
KOPPERS COMPANY, INC., *Fast's Coupling Dept.,* **221 Scott St., Baltimore 3, Md.**
Gentlemen: Please send me FREE Fast's Catalog giving detailed descriptions, engineering drawings, capacity tables and photographs.

Name.....

Company.....

Address.....

City.....Zone.....State.....

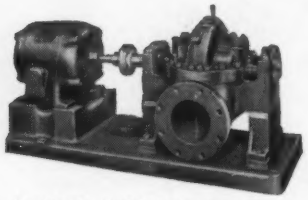


Ⓐ Composite performance curve of 5 sizes of Goulds Fig. 3305 pumps.

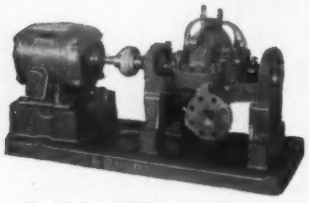
Ⓑ Composite performance curve of 19 sizes of Goulds Fig. 3405 pumps.

Do you need pumping capacity?

. . . or head? . . . or both?



Goulds Fig. 3405 single-stage pump.



Goulds Fig. 3305 two-stage pump.

With these two groups of Goulds centrifugal pumps you can meet an extremely wide range of pumping requirements.

For volume pumping, 19 sizes of the Fig. 3405 single-stage, double-suction pump provide capacities up to 6,400 GPM, and heads to 280 ft.

For greater pressure requirements 5 sizes of the Fig. 3305 two-stage pump provide heads up to 1,000 ft., and capacities to 1,200 GPM.

Both of these groups of pumps have important new design and construction features that insure efficient operation and long life. Yet, because so many of their parts are interchangeable, *you can cut your parts inventory in two—or better.*

For example, you need only 3 different shafts for all 24 sizes of pumps in both groups.

We'd like to send you additional details about these pumps, including specifications and performance curves. Just write for Bulletin 721.6 about the Fig. 3405 single-stage pumps, and Bulletin 722.6 about the Fig. 3305 two-stage pumps. We'll be glad to send you copies of both.

MEMBER HYDRAULIC INSTITUTE

Goulds PUMPS INC. Seneca Falls New York

ATLANTA • BOSTON • CHICAGO • HOUSTON • NEW YORK • PHILADELPHIA • PITTSBURGH • TULSA

More EQUIPMENT NEWS

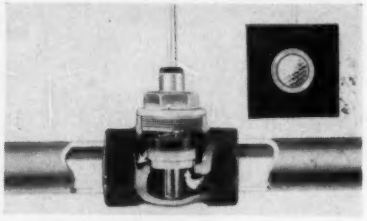
Begins on page 160

the load, eliminating any danger of sticking contacts. If a component fails or is broken in any position, control system becomes inoperable.

System requires operation of all switches in the control circuit within a pre-determined and adjustable time interval. Both hands must be on the controls and thus cannot be extended into the danger area. If an attempt is made to "cheat" the controls, or the control fails to operate properly, the control circuit instantly trips out. Automatic resetting is accomplished by releasing both hand switches or restoring damaged wire or parts to normal.

Further information available on request to the manufacturer.

Micro Switch, a div of Minneapolis-Honeywell Regulator Co, Freeport, Illinois



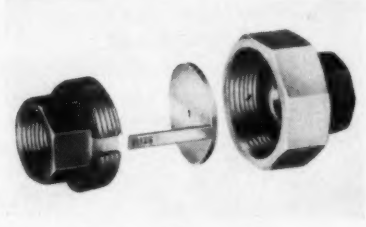
Compact flow indicator

120 • Instrument indicates flow (or lack of flow) of a liquid through a pipeline. Flow through unit actuates a switch that can be used to operate a pilot light, horn or other warning signal. With suitable relays it can also be used to operate preventive interlocks.

Present units accommodate standard pipe sizes from ¼ to 3 in. Normally, any flow over 1.5 gpm causes the indicator to function but higher or lower points can be provided on special order.

Gems Co, 64 Welles Drive, Newington, Conn.

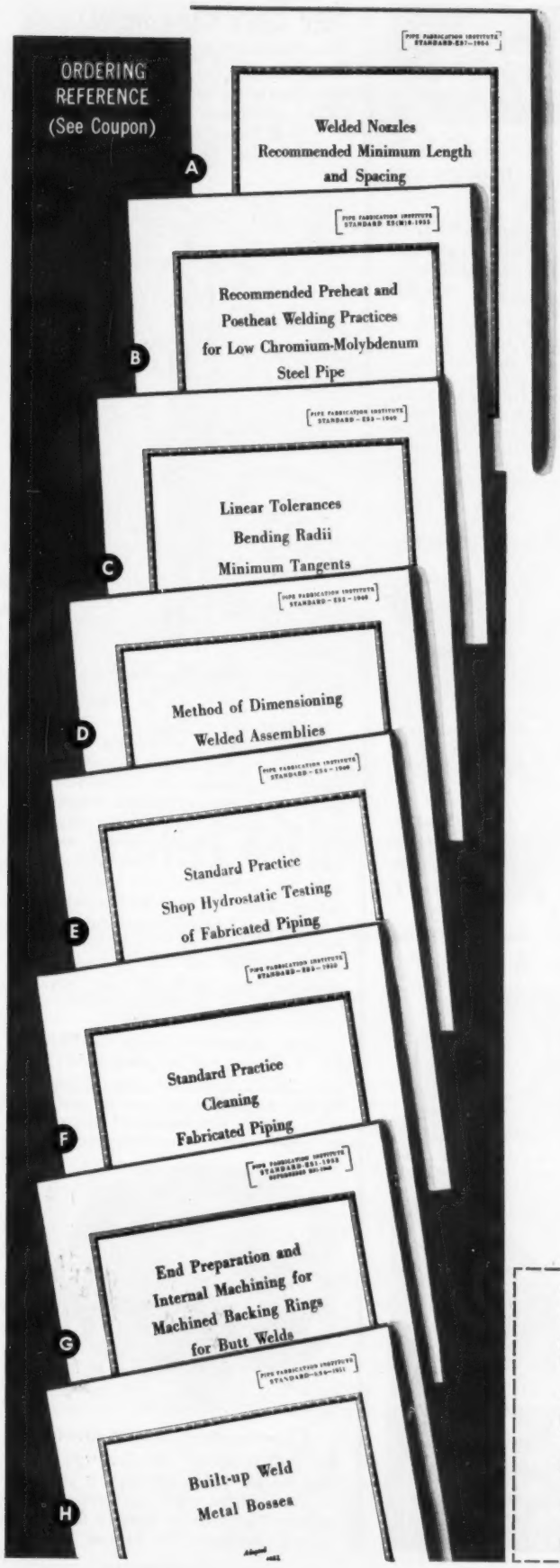
For more details on these items, use post cards p 169. Identify your request with item number.



Steel orifice union

124 • This 3000-lb *tab* orifice union is designed for instrumentation and process-control piping. Orifice size is plainly stamped on a tab that protrudes through a slot in end piece of union—eliminating errors in orifice plate identification. This tab is an integral part of the stainless-steel orifice plate.

Orifice plate is easily removed when it is desired to change flow conditions. Connecting pipes need not be pulled back



SAVE TIME • CUT COSTS • And Get BETTER PIPING by using THESE PFI STANDARDS

Good standards, understood and accepted by an industry, become a touchstone which speeds operation, improves product and reduces costs. The eight PFI Standards shown here were compiled by the Engineering and Standards Committee of the Pipe Fabrication Institute. They are now widely used by designers, fabricators, contractors and users of pressure piping. They often save time on the drawing board . . . expedite materials delivery . . . save time and money in erection. It all adds up to better piping quicker . . . and maximum value per dollar of cost.

These Standards are available without cost to anyone interested. Simply return the coupon or write on your company letterhead.

THE PIPE FABRICATION INSTITUTE

Devoted to the Technical and Economic Problems in Piping

One Gateway Center • Pittsburgh 22, Pa.

7365

THE PIPE FABRICATION INSTITUTE
One Gateway Center—Pittsburgh 22, Pa.

Please send me without obligation the PFI Standards I have circled below:

A B C D E F G H

☐ **Check here for copies of all future PFI Standards.**

NAME_____

ADDRESS_____

CITY_____ **STATE**_____

BIDDLE *Instrument News*

BIDDLE MOTOR ROTATION TESTER ELIMINATES GUESSWORK AND DANGER

SAVES TIME

in Electric Motor Hook-Ups

This tester eliminates the need for temporary connections which can be time consuming, costly, and quite hazardous, particularly where many large high-voltage motors are involved. With this instrument you can very easily determine direction of rotation for any size 1, 2 or 3-phase motor, and make your first connections *permanent* ones with safe assurance they are correct. You can use it also to test circuits, check phase sequence and identify windings of multi-speed or multi-voltage motors.

Write for BULLETIN 80-P

MEGGER® ELECTRICAL INSULATION TESTERS

Hand—Rectifier—or Combination Operation—

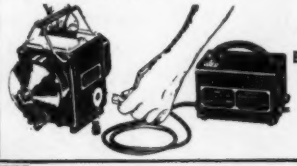
Ratings up to 2000 Megohms and 1000 Volts D-C

HAND CRANK MEG TYPE

of Megger Insulation Tester is a reliable field instrument, light, sturdy, with a constant-voltage type generator—no dependence on batteries or other current supply. By far the most popular instrument among electrical plant maintenance men. Easy to use—easy to read—and rugged in constant services.

RECTIFIER OPERATED Meg Type of Megger Insulation Tester simply plugs into a convenient outlet. Portable or flush bench-mounted. A dependable production or inspection instrument. Quick, easy readings speed up otherwise costly tests.

DUAL-OPERATED MEG TYPE of Megger Insulation Tester may be operated by hand or rectifier. Excellent solution for those requiring a versatile instrument for field and bench use.



Write for BULLETINS 21-45 P 21-46 P

IF YOU MEASURE SPEED • • • YOUR BEST BET IS BIDDLE

Average Measuring RPM or FPM Jagabi® Speed Indicator

Dr. Horn Tachometer

Jagabi® Tachometer

Instantaneous Speeds or Variations in Speeds. Write for BULLETIN 35-P

B-525

Frahm® Resonant Reed Tachometer Quick Accurate Readings with Safety BULLETIN 31-P

JAMES G. BIDDLE CO.

• ELECTRICAL TESTING INSTRUMENTS
• SPEED MEASURING INSTRUMENTS
• LABORATORY & SCIENTIFIC EQUIPMENT

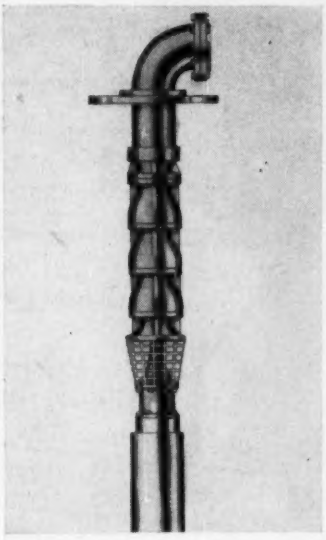
1316 ARCH STREET
PHILADELPHIA 7, PA.

More EQUIPMENT NEWS

Begins on page 160

any farther than required to slip the plate from between the two union ends.

Watson-Stillman Fittings Division, H K Porter Company, Inc, P.O. Box 95, Roselle, N. J.

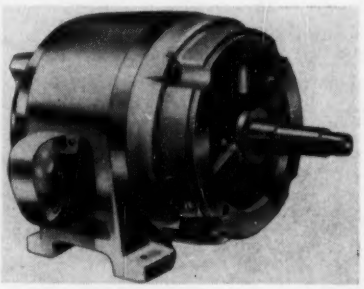


Submersible booster pump

131 • Standard models are available from 5 to 150 hp with discharge head 50 to 500 ft and 100 to 4000 gpm capacity. They are suited to typical sump, line booster, cooling tower, fire protection and barrel-pumping installations. Features claimed by manufacturer include oversize shaft, longer bearings with protective caps, perihedral impeller seals, mechanical shaft seal designed specifically for submerged service and a choice of either mixed-flow or radial-flow impellers. Unit utilizes a General Electric submersible motor with a larger oil reservoir and spring-loaded resilient bag that permits sealed motor to breathe with changing pressures and temperature. Descriptive bulletin available on request to manufacturer.

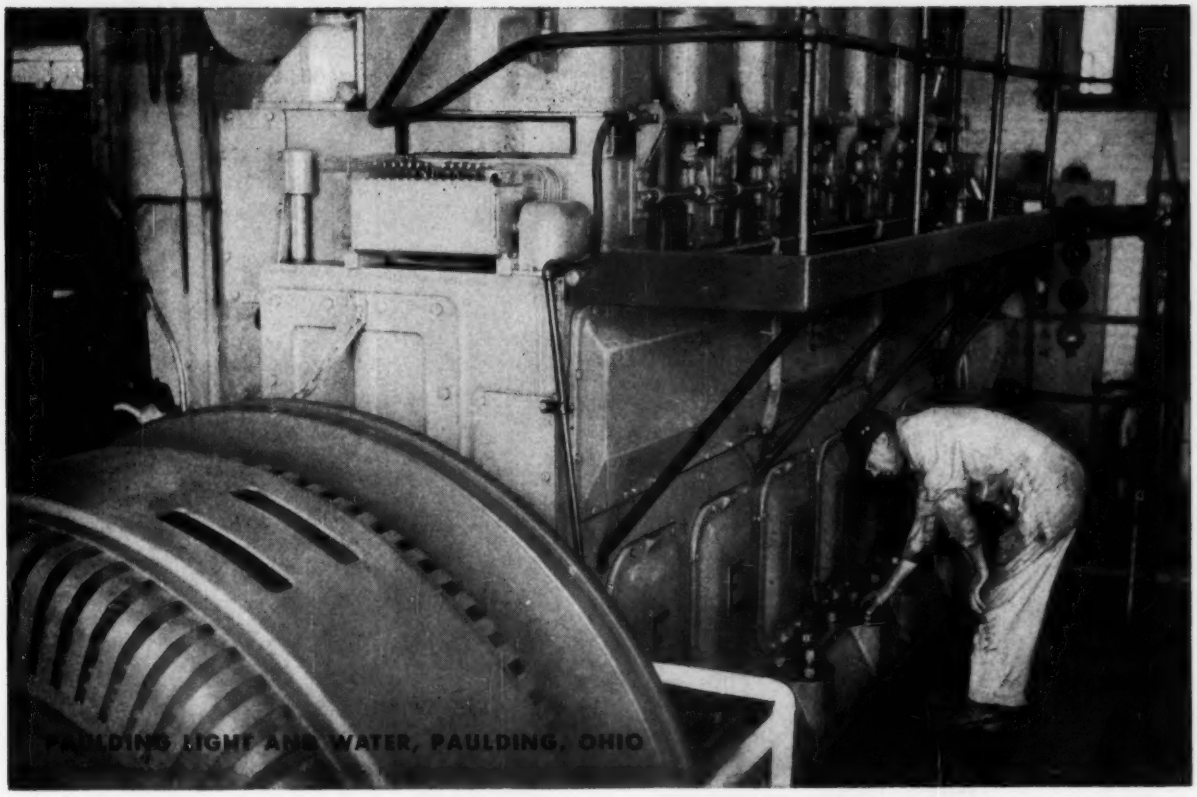
Layne & Bowler Pump Co, 2943 Vail Ave, Los Angeles, Calif.

For more details on these items, use post cards p 169. Identify your request with item number.



Close-coupled pump motor

126 • This motor, with face-type registered bracket and special shaft, is designed for close-coupled centrifugal pump applications. Pump may be mounted flush with motor by bolting to face bracket. To pre-



"16,587,402 H. P. hours without oil change using Cities Service C-300 Lube Oil!"

1000 KW Enterprise uses only one gallon of oil in 23,205 BHP hours, has no oil reclaimer.

The main part of the power output of Paulding Light and Water Company is developed by its dual-fuel, 1000 KW Enterprise Unit.

Mediocre performance can't be tolerated at Paulding . . . the power load is running twice that of seven years ago!

"Fortunately," says Superintendent James J. Leslie, "performance is tops—and much of the credit is due Cities Service C-300 Lube Oil. We really pile up hours with C-300 . . . and still get excellent engine life. I've never had the head off the Enterprise since it was first installed in 1953, yet compression, fire pressure, and fuel economy are still very good.

"We've actually logged up to 16,587,402 H.P. hours without an oil change. We use only 1.5 gallons of C-300 Lube Oil per day, which amounts to 23,205 brake-horsepower hours per gallon . . . and that's with no oil reclaimer! I'd recommend Cities Service to any power plant."

If you're interested in Mr. Leslie's recommendation, talk with your Cities Service Lubrication Engineer. He can tell you of other outstanding case histories. Or write: Cities Service Oil Co., Sixty Wall Tower, New York 5, N. Y.

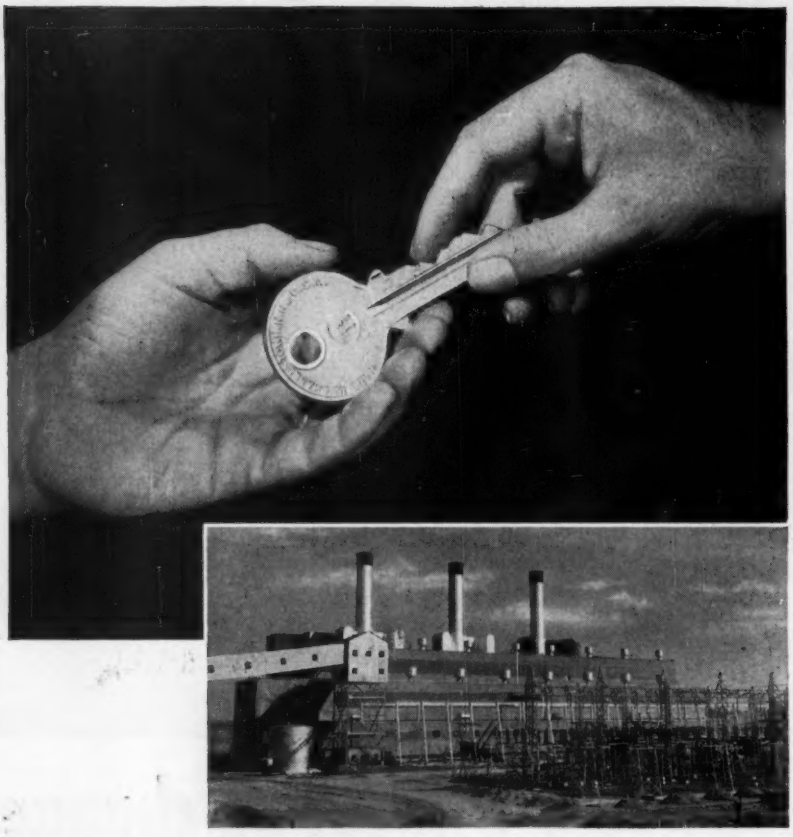
Electric Service Goes Hand in Hand with Cities Service at Paulding Light & Water. Paulding's Enterprise dual-fuel power unit gets 23,205 BHP hrs. for every gallon of Cities Service C-300 Oil that's consumed. Oil changes are made about every 11,000 hrs.

"We're Really Able to Pile Up Hours and still get good engine life using Cities Service C-300 Lube Oil," says Supt. Leslie. "I've never had the head off the Enterprise since it was installed in 1953. Compression, fire pressure, and fuel economy are excellent."

CITIES SERVICE

QUALITY PETROLEUM PRODUCTS

WHY A TURN-KEY PROJECT IS BEST FOR YOU



A Turn-Key project is a "packaged" service that combines engineering and construction in a single contract . . . and that may include other services such as preliminary investigations, studies and site selection, procurement of materials and equipment, initial operation of the finished plant.

Advantages to you:

LESS COST: Who is better qualified to construct a project than the firm that designs it? In a Turn-Key project one organization performs both engineering and construction services; details are handled quickly, efficiently—therefore more economically.

LESS TIME: Excavation can be made and foundations started several months prior to the release of the Engineer's completed design drawings and specifications. Construction follows blue prints—promptly. This scheduling of design and procurement to meet construction requirements permits the project to advance in an unbroken sequence—setting the stage for a faster delivery of the completed plant.

MORE SERVICE: One contract gives you *complete* service—no question about responsibility. Thus you have better control and more closely integrated planning.

We offer you engineering and construction services separately but suggest you consider combining them into a Turn-Key project that will save you both time and money. Write today for this free booklet describing the advantages in detail.

POWER • AVIATION • PETROLEUM • TEXTILES • INDUSTRY

The Kuljian Corporation

engineers • constructors

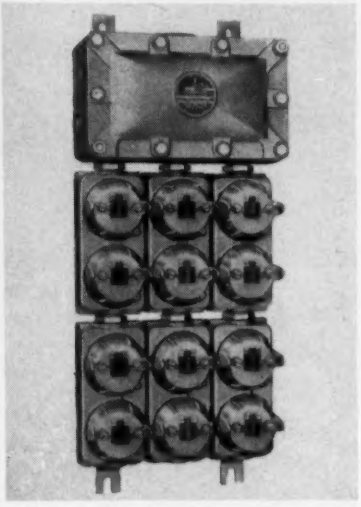
1200 North Broad Street • Philadelphia 21, Penna.

More EQUIPMENT NEWS

Begins on page 160

vent water from entering motor a solid flange and brass slinger are incorporated. Shaft is stepped with special diameters and has shoulder and tapped hole for mounting the impeller. Units are rated from 1 to 30 hp. Further details on request.

U.S. Electrical Motors Inc, Box 2058, Terminal Annex, Los Angeles 54, Calif.



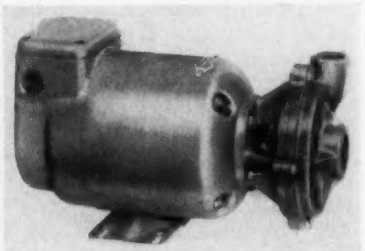
Explosion-proof panelboards

122 • *Type EWP* panelboards are designed for hazardous locations and for installations where corrosive vapors, noncombustible dusts or moisture are present. Functioning either as load centers or panelboards, they provide circuit protection on wiring systems up to 120 volts. All terminal blocks are located in the upper housing—completely accessible for connecting both the main and branch circuits on installation.

Circuit breaker housing contains either two single-pole or one two-pole breaker. All panelboards have pipe plugs in one-half of the branch hubs and seals are provided between all housings. Details on request.

Crouse-Hinds Co, Wolf & 7th North Sts, Syracuse 1, N. Y.

For more details on these items, use post cards p 169. Identify your request with item number.



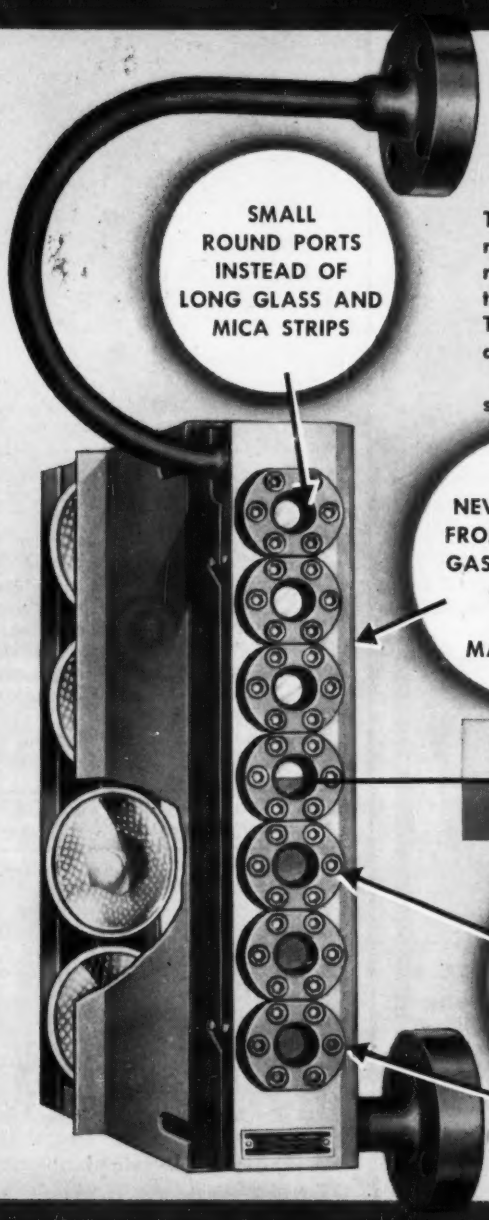
Small centrifugal pump

125 • *Model D-500* pump is a 1/20-hp unit equipped with self-adjusting pre-tested seal. It is designed for use in closed, semi-closed or open systems and can be mounted at any convenient point—either in horizon-

MAKING Great Savings in GAUGE MAINTENANCE

(BOTH TIME AND COST)

DIAMOND "Multi-Port" BI-COLOR GAUGE


SMALL ROUND PORTS INSTEAD OF LONG GLASS AND MICA STRIPS
GAUGE NEVER REMOVED FROM BOILER FOR GASKET CHANGES OR OTHER NORMAL MAINTENANCE
STEAM SHOWS RED
WATER SHOWS GREEN
COMPLETE PORT CHANGE REQUIRES ONLY ABOUT 15 MINUTES
EACH PORT THERMALLY INDEPENDENT

The Diamond "Multi-Port" Bi-Color Gauge makes startling reductions in maintenance costs. In cases where accurate records have been kept, labor and material costs are less than 1/5 the maintenance of conventional open port gauges. This is due to the unique design . . . note particularly the advantages that are pointed out on the photograph.

The "Multi-Port" operates on the Bi-Color principle . . . steam always shows red . . . water always shows green. There can be no question of water level. The gauge has been in continuous successful high pressure operation for more than three years in leading central station plants. Users report excellent readability and exceptionally high availability as well as important reductions in maintenance. Return the coupon below to get a copy of Bulletin 1174U.

7320

DIAMOND POWER SPECIALTY CORP.
LANCASTER, OHIO

Diamond Specialty Limited — Windsor, Ontario

DIAMOND POWER SPECIALTY CORP.
LANCASTER, OHIO

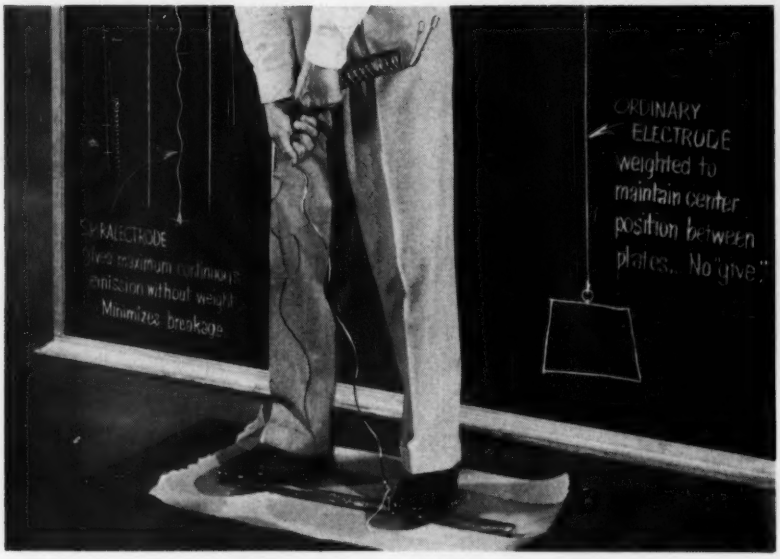
Please send me without obligation a copy of new Bulletin No. 1174U explaining the advantages of the Diamond "MULTI-PORT" Bi-Color Gauge.

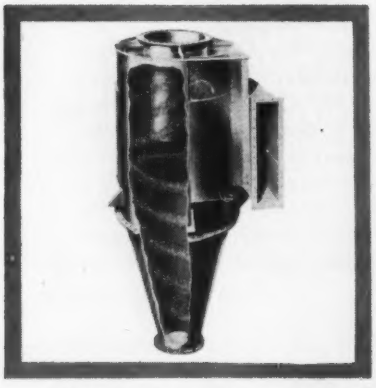
NAME_____

COMPANY_____

ADDRESS_____

Electrode Breakage is no problem in Buell "SF" Electric Precipitators

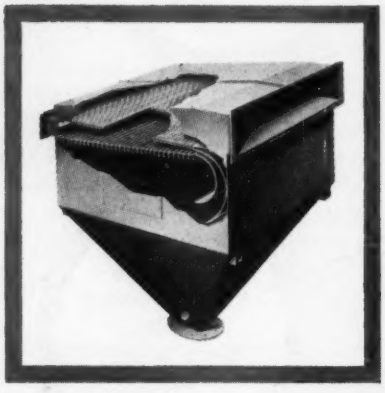




Buell Cyclones offer two "extra-efficiency" advantages: (1) exclusive shave-off which harnesses double-eddy and puts it to work, and (2), large diameter design which eliminates clogging.

Buell's Low Resistance Fly Ash Collector combines top efficiency with low draft loss, for natural or forced draft installations. Ideal for boilers from 100 to 2000 BHP.

Besides eliminating efficiency drops and "shutdowns" due to electrode breakage, Buell's unique Spiralectrode permits higher and more constant emission, extra efficiency. Also, Continuous Cycle Rapping—another Buell exclusive—keeps electrodes constantly clean for maximum efficiency...at all times!



For more specific data about Buell's *extra efficiency*, write Dept. 50-A
Buell Engineering Company,
70 Pine Street, New York 5, N. Y.

buell

MECHANICAL ELECTRICAL

Experts at delivering Extra Efficiency in

DUST COLLECTION SYSTEMS

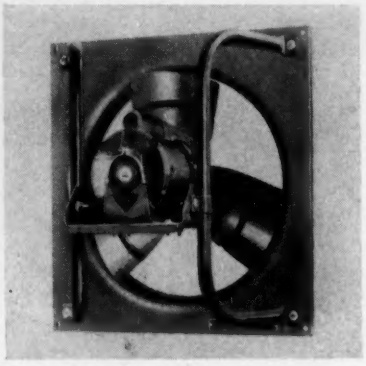
More EQUIPMENT NEWS

Begins on page 160

tal, vertical or angular position, without restriction to the high level line of the liquid in the reservoir.

Discharge relation is interchangeable in four 90 degree positions. The pump is available in either cast iron or bronze.

The Ruthman Machinery Co, Cincinnati 2, Ohio



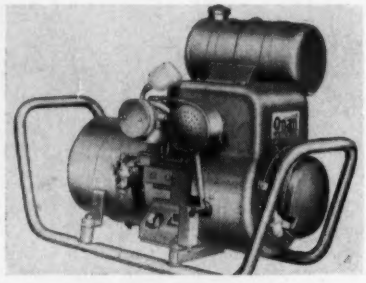
Propeller exhaust fan

132 • Heavy-duty propeller-type exhaust fan is designed specifically for industrial installations. It is available with 2-speed or constant-speed direct-drive totally-enclosed motors. A large range of sizes are offered with capacities from 587 to 12,800 cfm. The new design will operate against static pressures to ⅝ in. Streamlined inlet permits free flow of air with minimum resistance in exhausting smoke, fume and other contaminates.

Air delivery ratings are in accordance with standard test code for centrifugal and propeller fans and conforms with appropriate U.S. Dept of Commerce commercial standards. Details on request.

American Blower Corporation, Detroit 32, Mich.

For more details on these items, use post cards p 169. Identify your request with item number.



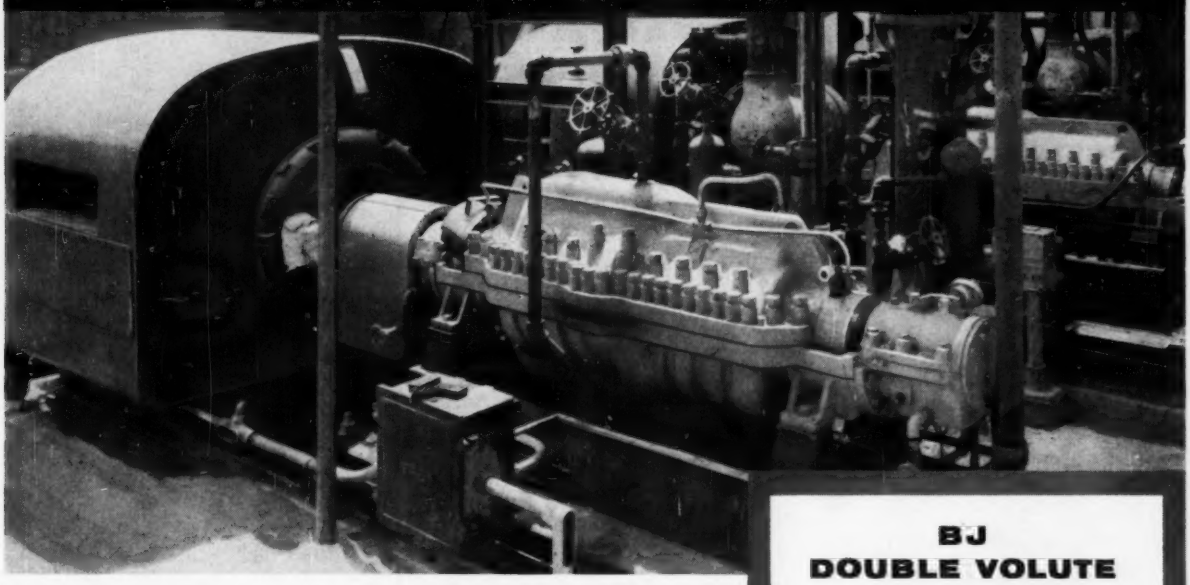
Portable electric plant

134 • Lightweight 1500-w, 60-cycle ac electric plant is offered in two versions. *Model 105AK-1P* weighs only 125 lb, is equipped with tubular aluminum carrying frame as standard equipment. *Model 105AK-1M* weighs 130 lb, is designed for stationary service but with carrying frame and 2-wheel dolly optional.

In both models the all-climate generator is direct-connected to a 4-cycle air-cooled gasoline engine. Features include rotating

NEW Byron Jackson DVMX
SPLIT CASE BOILER FEED PUMP

...Engineered for Medium Size Power Plants



This new Byron Jackson DVMX split case pump gives the same trouble-free service that BJ barrel type Boiler Feed Pumps have been providing for the larger power plants in the United States for many years. This DVMX model is engineered primarily for medium-sized power plants and delivers capacities to 2200 gpm, heads to 1200 psig. and temperatures to 350° F.

Here's what you get in the new DVMX

1 Horizontally-split case, with both nozzles in the lower half of the pump case, permitting removal of the top half of the case and the complete rotating element without disturbing the piping.

2 Double volute design which assures radial balance of the pump at all capacities.

3 Impellers arranged in equally opposed groups, assuring hydraulic axial balance without resorting to the use of any auxiliary high pressure balancing devices.

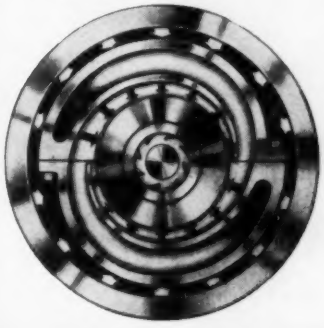
4 Available with reliable BJ high pressure Mechanical Seal especially designed for boiler feed service.

5 Furnished with a spacer type coupling for easy removal of the mechanical seal.

6 The thrust and radial bearings including the self-contained oiling system are of the same reliable construction that has proven so successful over the years in the larger BJ barrel type Boiler Feed pumps. The oiling system is of ample size to supply the driver bearings if desired.

BJ DOUBLE VOLUTE

By the use of BJ Double Volute inner cases, the flow is divided into two identical fluid channels with outlets 180° apart. Equal opposing forces are created, resulting in radial balance without pressure-bending moment on the shaft.



BJ MAKES BOILER FEED HISTORY!

Byron Jackson is building the world's largest boiler feed pump. This 12,000 HP pump will deliver 6,330 gallons per minute at total head of 6,400 feet, or about 2700 pounds per square inch, at a speed of 3510 RPM.

Byron Jackson

Division of Borg-Warner Corporation
P.O. 2017, Terminal Annex, Los Angeles 54, California

BJ

Here's Why Aeromaster Fans

mean more satisfactory cooling equipment operation

Manufacturers and users of cooling equipment agree... Aeromaster Fans give outstanding service. Here are the reasons why.

Aeromaster Fans are *precision engineered,* adapted from high speed aircraft propellers. They have adjustable blade pitch and anti-flutter design . . . therefore, require less horsepower. And they last longer too, thanks to the exclusive Aeroloid blade coating to resist acids and alkalies, abrasion and weather. Overall result: Aeromaster Fans *give more cooling at lower cost.*

Available in 4, 6, or 8 blade styles, in diameters of 5 to 24 ft., with capacities up to 1,000,000 cubic feet per minute, all Aeromaster Fans are fully guaranteed.

Koppers also has trained engineering specialists available in principal cities, insuring prompt, expert Aeromaster Fan service. And Koppers is always ready to consult with you on special fan problems. Next time you plan a replacement of present fans, specify Aeromaster. And when you consider new equipment, call on Koppers . . . always eager to be of service.

KOPPERS

Aeromaster Fans

METAL PRODUCTS DIV. • KOPPERS COMPANY, INC. • BALTIMORE, MD. • This Koppers Division also supplies industry with Fast's Couplings, American Hammered Industrial Piston and Sealing Rings, Koppers Electrostatic Precipitators and Gas Apparatus. *Engineered* Products Sold with Service

MAIL COUPON TODAY FOR COMPLETE INFORMATION

KOPPERS COMPANY, INC., *Aeromaster Fans,* 261 Scott St., Baltimore 3, Md.
Gentlemen: Please send me detailed information on Aeromaster Fans for

_____
(name and type of equipment to be cooled)

Name _____

Title _____ Company _____

Address _____

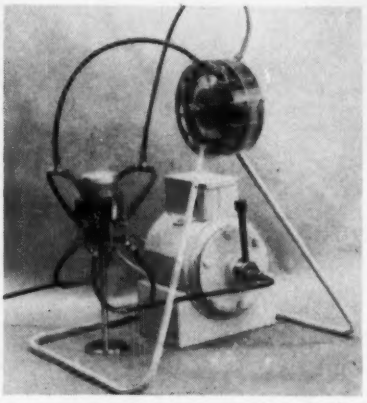
City _____ Zone _____ State _____

More EQUIPMENT NEWS

Begins on page 161

stellite - faced exhaust valve, solid stellite exhaust insert, built-in governor and high-tension radio-shielded magneto ignition. Unit will run for approximately three hours on one gallon of gasoline at full rated load.

D W Onan & Sons, Inc, Minneapolis 14, Minn.



Controlled volume pump

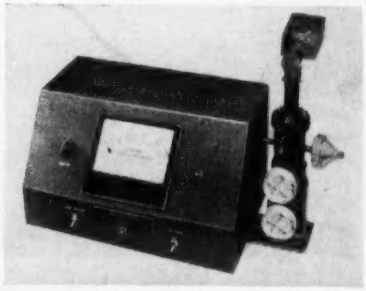
130 • Units, designed for downhill pumping, accurately meter liquids or gases against negative discharge pressures. Based on a unique pumping concept these units are suited for all low-capacity flow-control problems that involve metering from high suction to lower discharge pressure. Manufacturer states that pumps are immune to pressure variations in the system—only requiring that suction pressures be maintained (naturally or mechanically) at least 5 psi above discharge pressures.

Units are available in four standard sizes of approximately 3, 15, 75 and 375 ml per cycle. Capacity is manually or automatically adjustable during operation through either stroke length or speed control. Standard materials of construction are 316 stainless steel with neoprene or tygon trim.

Leakproof construction with no running seals or stuffing boxes enables unit to handle dangerous and highly-corrosive materials.

Milton Roy Co, Station L, 1300 E Mermaid Lane, Philadelphia, Pa.

For more details on these items, use post cards p 169. Identify your request with item number.



Aerosol and smoke photometer

123 • Portable unit is designed for the study, measurement and control of air pollution and particulate matter suspended in

These are Zallea Pressure-Balanced Expansion Joints. They provide a sound engineering solution to the problem of absorbing pressure thrust where a change in direction occurs, and it is not possible to anchor the elbow.

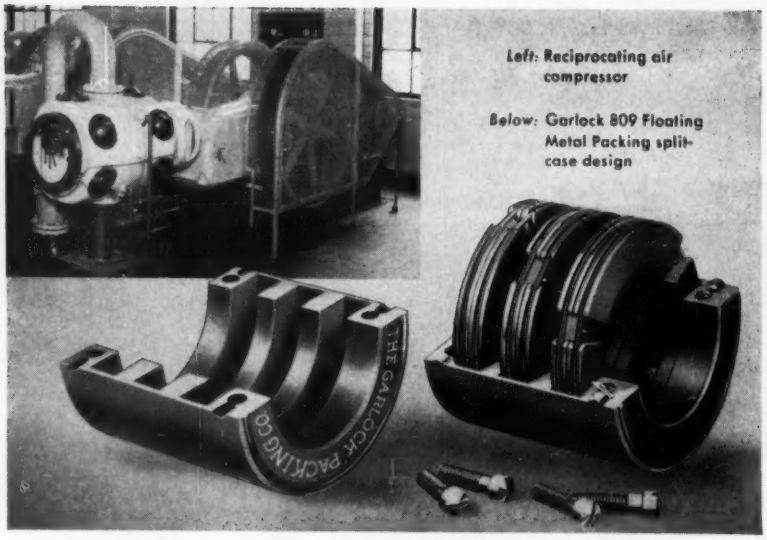
Their operation is simple. Both expansion joints shown are designed to absorb axial and lateral movement in the inboard bellows. By means of tie rod action, the pressure thrust of the inboard bellows is balanced by the countermovement of the outboard bellows. This design is frequently used in piping connections to a turbine to eliminate the pressure thrust against the turbine casing. Many other applications may occur to the design engineer.

An original Zallea design, these specialized joints are another example of our ability to develop, engineer and manufacture expansion joints to meet your specific needs. For information on standard types, or help with special expansion or piping problems, call in a Zallea representative.

Zallea *expansion joints*

ZALLEA BROTHERS 814 LOCUST STREET, WILMINGTON 99, DELAWARE

World's Largest Manufacturers of Expansion Joints



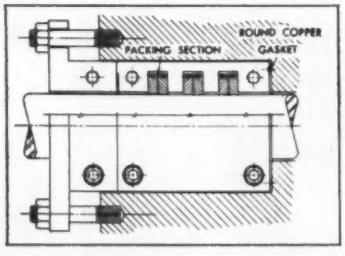
Left: Reciprocating air compressor

Below: Garlock 809 Floating Metal Packing split-case design

For air compressors, users report

GARLOCK SPLIT-CASE METAL PACKINGS

have 2 big advantages



1. **LONG, TROUBLE-FREE LIFE.** Minimum of 7 years with proper lubrication.

2. **CAN BE INSTALLED *WITHOUT* DISCONNECTING THE ROD.** Downtime is reduced to a minimum.

You can eliminate the cost of frequent packing replacements and unnecessary downtime by installing Garlock split-case metal packings on your reciprocating air compressors. Service reports show that these Garlock metal packings have given 15 years and more of trouble free service with a minimum of rod wear.

For complete information, call your Garlock representative or write today for Brochure 3889.

THE GARLOCK PACKING COMPANY, PALMYRA, N. Y.

Sales Offices and Warehouses: Baltimore, Birmingham, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Denver, Detroit, Houston, Los Angeles, New Orleans, New York City, Palmyra (N.Y.), Philadelphia, Pittsburgh, Portland (Ore.), Salt Lake City, San Francisco, St. Louis, Seattle, Spokane, Tulsa

In Canada: The Garlock Packing Company of Canada Ltd., Toronto, Ont.

GARLOCK

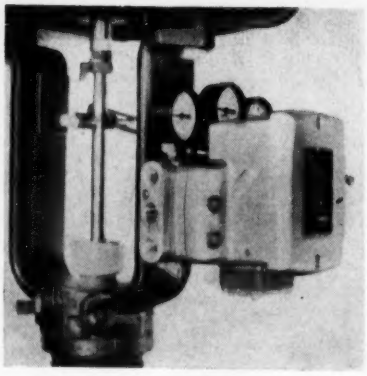
PACKINGS, GASKETS, OIL SEALS,
MECHANICAL SEALS, RUBBER EXPANSION JOINTS

More EQUIPMENT NEWS

Begins on page 160

aerosols. Applications include rapid evaluation of filter designs, testing efficiency of fans, air-wash systems and air conditioners. Instrument features extreme sensitivity by measuring forward-scattering at small angles that may be 100 to 10,000 times greater than the scattering in all other directions.

Phoenix Precision Instrument Co, 3803 N 5th St, Philadelphia, Pa.



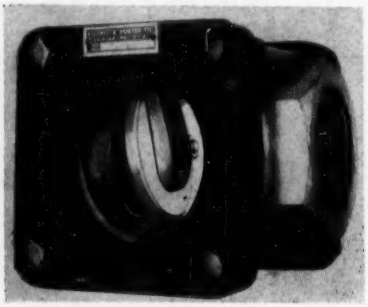
Valve positioner

135 • Designed for precise control action, positioner overcomes friction and reduces line effects—speeding valve response to controller signal. Its applications include large-volume diaphragm motors and processes where controller-to-valve distances are long.

A simple motion balance device, the positioner receives a controller output signal at a spring-opposed bellows that governs a flapper-nozzle relationship. Back pressure in nozzle circuit acts on a high capacity air relay to vary supply pressure to valve motor. Full pressure can be applied to motor on a controller output change of less than 2-in. of water. As valve stem moves to correct position, a lever connected to stem rotates positioners shaft which, through a spring and ball arrangement, restores the flapper-nozzle relationship to a point of balance. Details on request.

The Foxboro Co, Foxboro, Mass.

For more details on these items, use post cards p 169. Identify your request with item number.



Sight flow indicator

127 • Check-valve indicator has a self-aligning soft seat flapper that prevents back flow, according to manufacturer. Two ½-in. thick windows on opposite sides of

Introducing . . .

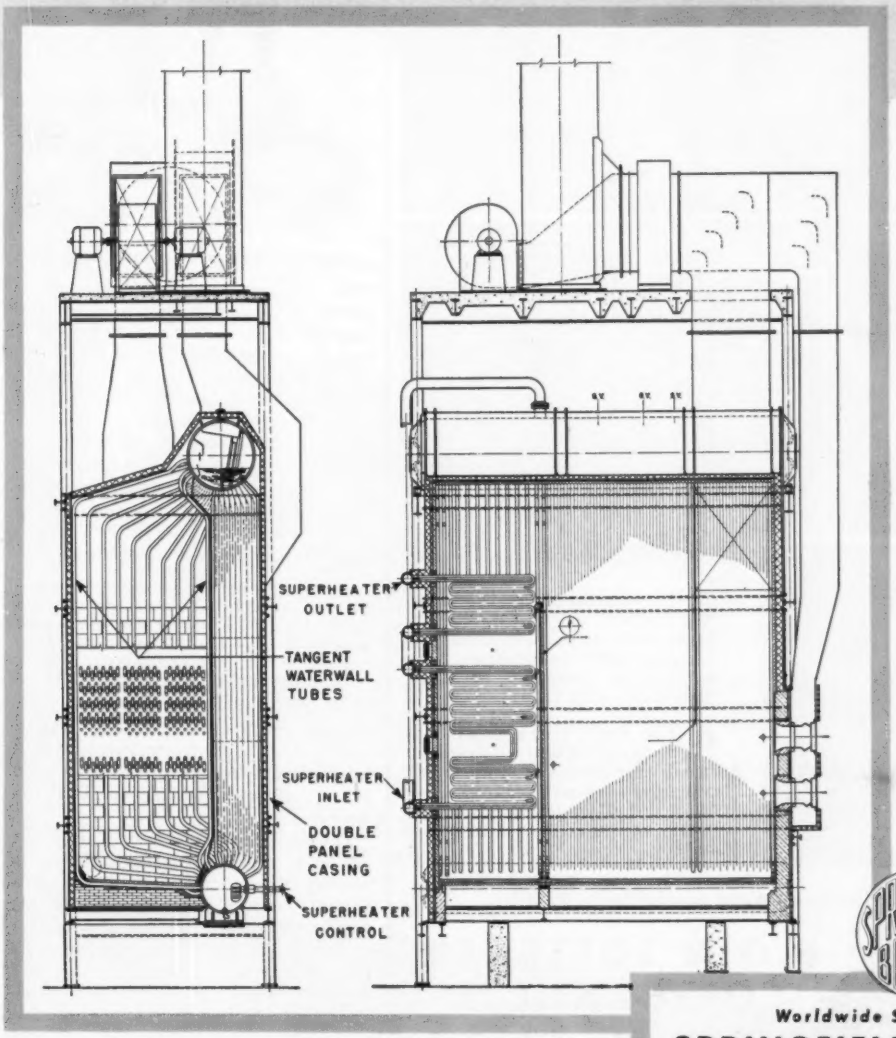
Springfield's New Headerless Steam Generators

SPRINGFIELD BOILER CO., America's first builder of waterwalls for boiler furnaces . . . pioneer builder of divided furnaces . . . and originator of many special features in package boilers, now offers a distinctively new line of specially designed, field erected steam generators that are:

1. Remarkably lower in initial cost.
2. Quicker and simpler to erect.
3. Suitable for indoor or outdoor installation. Completely steel enclosed.
4. Capable of quick starting and quick steaming. Fast circulating.
5. Highly efficient and suited to either pressurized or balanced draft firing. Guaranteed performance.
6. Compact in dimensions and adaptable to user's space requirements.
7. Easier, simpler, and less expensive to operate and maintain.

All waterwall and boiler tubes connect directly to the drums. Tangent tubes are used in the sides, roof, and bottom waterwalls. Water-steam circulation friction is reduced to less than one-quarter of that of conventional designs. The rapid circulation obtained contributes to clean operation, quick steaming, and long tube life.

Units of this type are particularly suitable for installations in the range from 50,000 to 150,000 lbs. per hour. Heat recovery and superheat equipment can be provided as desired. Control and operation can be made virtually automatic. *For detailed information, write or call Springfield today.*



New Unit:

The design shown at the left in front and side elevations is one of Springfield's new headerless generators being built for the City of Chanute, Kansas.

DATA

Des. Pres.	475 psig
Opr. Pres.	425 psig
FST (con.)	750° F.

Continuous Capacity 125,000 lb./hr.

Fuel: Nat. Gas or Oil

Heat Recovery: Air Heater

Consultants
Universal Engineering Company, McPherson, Kansas

Check with Your Consulting Engineer on Modernization and New Plant Projects

Designers and Builders of
BENT TUBE BOILERS • STRAIGHT TUBE BOILERS
SUPERHEATERS • DESUPERHEATERS • AIR HEATERS
ECONOMIZERS • PACKAGE BOILERS

Worldwide Sales and Service

SPRINGFIELD BOILER CO.

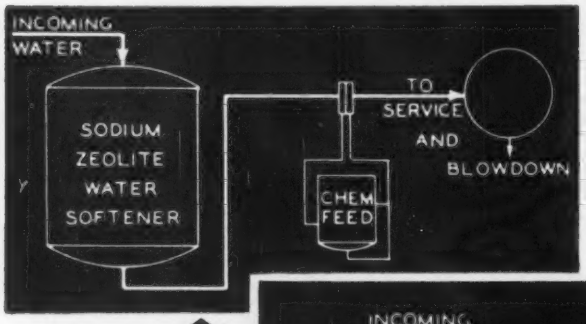
FOUNDED IN 1890

1953 E. Capitol • Springfield, Illinois

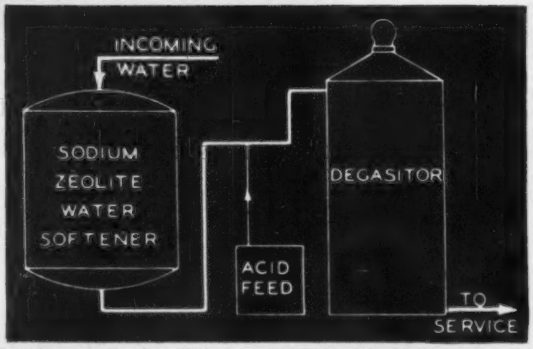
See our catalog in SWEET'S

Elgin CAN solve your water conditioning problem!

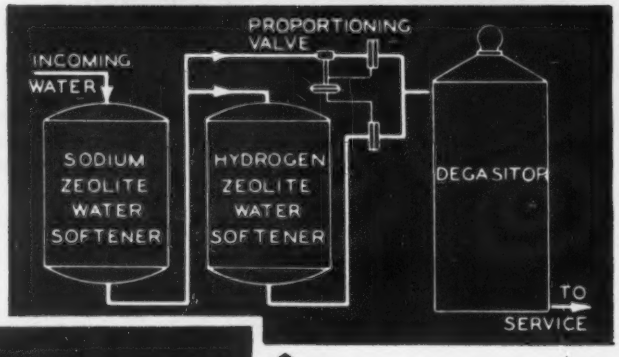
During the years since 1908, it's probable that Elgin engineers have faced — and solved — nearly *every* industrial water conditioning problem. Whether simple or complex, there's an Elgin water conditioning system designed to meet your water treatment requirements — efficiently and economically. Here are four typical examples:

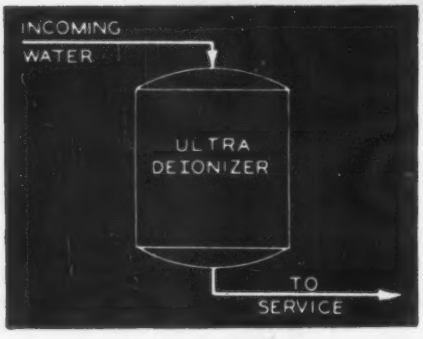


1 In many plants, ordinary ion-exchange softening, plus chemical treatment will deliver soft, scale-free water that will prevent corrosion and corrosion products.



2 Where softened water is too alkaline, the answer often lies in sodium ion-exchange softening with acid feed for neutralization, plus degasification for CO_2 removal.





3 For effective reduction of total dissolved solids, blended sodium and hydrogen ion-exchanger softening, plus degasification, will produce soft, scale-free, low-alkalinity water with CO_2 removed.

4 The Elgin Ultra-DeIonizer produces water of highest known chemical purity. This single-tank mixed-bed unit removes CO_2, silica, and all ionizable solids . . . in limited space and at very low cost.

See Your Elgin Representative or Write for Complete Details

ELGIN Economical WATER CONDITIONING FOR EVERY NEED

ELGIN SOFTENER CORPORATION

130 N. Grove Ave., Elgin, Ill.

Representatives in Principal Cities

In Canada: G. F. Sterne & Sons Ltd., Brantford

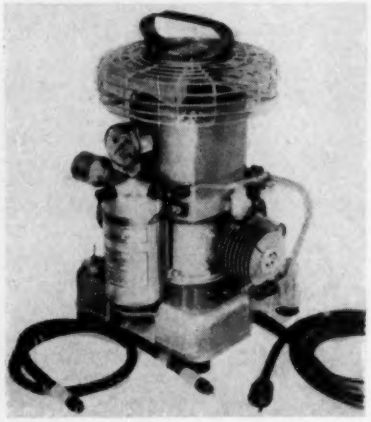
More EQUIPMENT NEWS

Begins on page 160

the body fitting—removable for easy cleaning—show clearly whether or not there is a flow. Indicator does not measure the rate of flow.

Designed primarily for liquified-petroleum-gas and anhydrous-ammonia service, it may be used for other applications requiring flow indication with positive check of back flow. Standard sizes are for 2-in. pipe with an operating pressure rating of 250 psi and for 1½-in. pipe with a rating of 300 psi. Further details on request.

Fischer & Porter Company, 544 Jacksonville Rd, Hatboro, Pa.



High-pressure air compressor

128 • Portable compressor has a capacity of 1.75 cfm of free air and a rated discharge pressure of 3000 psi. It weighs only 38 lb and has an over-all height of 17 in. The complete assembly includes compressor, oil filter and moisture separator, self-resealing relief valve, 0-4000-psi pressure gage and an integral 110-220-volt 60-cycle ac motor. Unit operates at 3450 rpm and has three stages of compression. Both compressor and motor are air cooled.

The Cornelius Co, 550 39th Ave, NE, Minneapolis 21, Minn.

For more details on these items, use post cards p 169. Identify your request with item number.

Nuclear safety-control device

136 • Hydraulic-control rod-drive mechanism is designed for non-military nuclear power plants and research reactors. It automatically shuts down a reactor plant before a disastrous nuclear "incident" can occur.

Outstanding safeguard built into the control is rapid "scram" in response to warning signals—within a fraction of a second. Pressure differentials within hydraulic components are arranged so that oil leakage, if it develops, will drive affected rod toward reactor core to decrease reactivity. Pressures in drive mechanism's accumulator are monitored by controls that automatically cause scram when pressure drops below a set value.

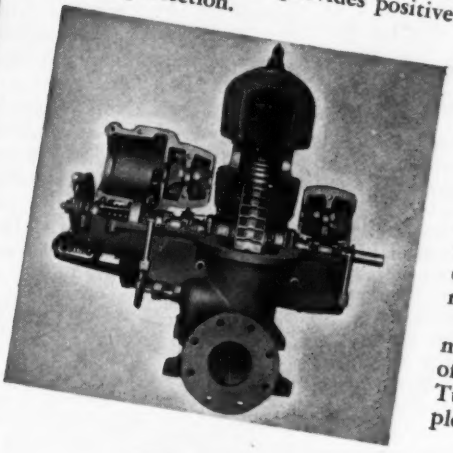
Ford Instrument Co, 31-10 Thomson Ave, Long Island City 1, N. Y.

TERRY

PROTECTION OF TURBINE BLADES made possible by nozzle location

The Terry Solid-wheel Turbine is of the impulse, helical flow type. The steam issues from an expanding nozzle at high velocity and enters the wheel bucket where its direction is reversed 180°. As this single reversal uses but a portion of the available energy, the steam is returned to the wheel several times until practically all of the energy has been utilized. This principle makes possible the efficient use of steam in a single-piece, almost indestructible wheel.

In the Terry Solid-wheel Turbine, the steam enters the buckets in a direction at right angles to the shaft, as shown above. This design eliminates the need for close clearances and provides positive blade protection.



The blades cannot foul. There is a one inch clearance on either side of the wheel. In addition, projecting rims on each side of the buckets prevent damage to the blades even though external thrust should move the wheel.

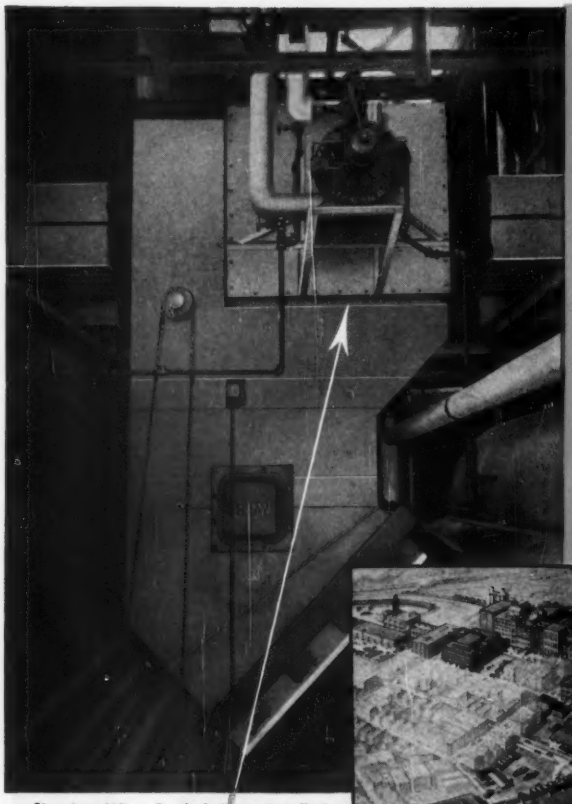
This is only one of the many important features of the Terry Solid-wheel Turbine. Write for complete details.

THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

TT-1195

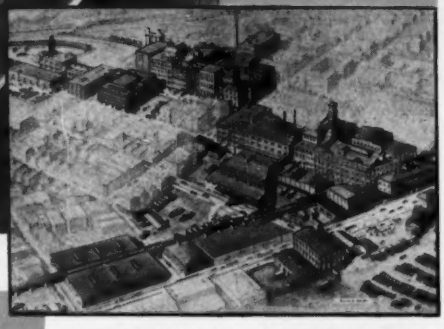
Memo

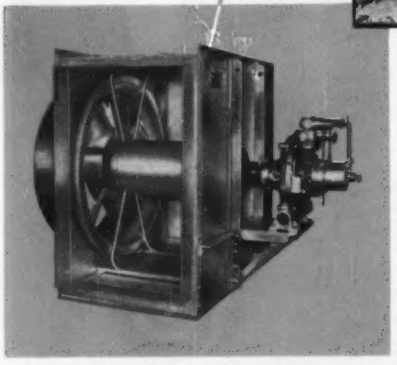
Send for a copy of bulletin S-116 which describes the many advantages of the Terry Solid-wheel Turbine.



Showing Wing Draft Inducer installed as elbow in breeching.

SPACE PROBLEM SOLVED BY WING PACKAGED POWER PLANT DRAFT INDUCER





WING POWER PLANT DRAFT INDUCER
May be Turbine or Motor-Driven. Fan and bearing assembly may be withdrawn from housing for inspection and servicing.

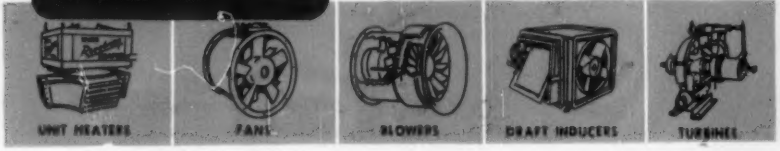
at BALLANTINE'S
one of the country's leading breweries

At P. Ballantine & Sons, Newark, N.J., a 70,000 lb./hr. boiler was installed with forced draft supplied by a Wing Turbine Blower. A 200-foot stack served this and one other boiler. Lightning removed 30 feet of the stack making the chimney draft inadequate. Conventional fans, because of large space requirements, would not do. A Wing Packaged Draft Inducer was installed in the existing breeching with no major changes and within the available space. *More facts about Wing Draft Inducers in Bulletin I-55. Use the coupon.*

L. J. Wing Mfg. Co.
50 Vreeland Mills Rd., Linden, N.J.
Factories: Linden, N.J. & Montreal, Can.

Wing

L. J. Wing Mfg. Co., Linden, N. J. P-1
Please send me bulletin on WING DRAFT INDUCERS.
Name.....
Firm.....
Address.....
City.....Zone.....State.....



MARMADUKE

Continued from page 148

various dam sections.

"Then one day a leak showed up in a machinery room of the powerhouse. The leaking wall was several feet thick and 30 feet below the lake level. After a few days she started squirting a stream the size of a cigarette. That wasn't bad, but no leak could be tolerated in that space. While not serious just then, it had to be stopped. Question everybody asked was 'How?' Stopping that leak wasn't my job so I kept my mouth shut. Maybe I'd learn something.

"The thick concrete wall had been poured in several lifts. So I knew the leak could originate on the wall's upstream side in any one of several places. I've seen such leaks stopped by dribbling ashes down along the upstream side. Then the fine particles are forced into the crack, stopping the leak. To have even a Chinaman's chance, the suspected area on this dam was so large that carloads of ashes would have to be used. To my surprise, the new super did try ashes.

"If the exact spot on the upstream side were known, it could be stopped by a deep-sea diver. But that would cost money and I wouldn't try it if I were in charge unless everything else failed.

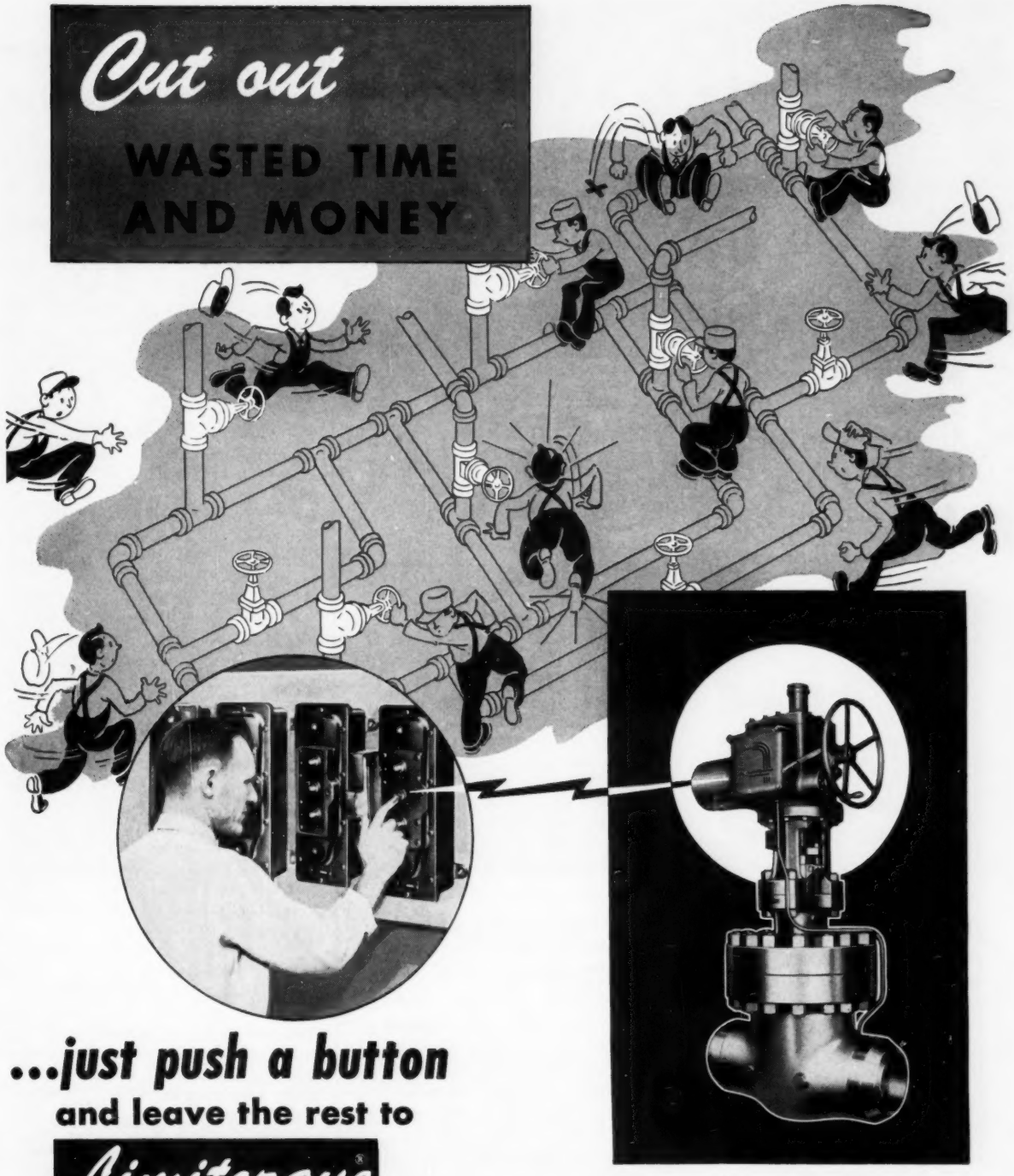
"Unwatering that 65-mile-long lake was out of the question. Then I heard talk of calking the downstream side. Someone mentioned putting in a concrete patch. Trouble was no one knew how to hold that 30-ft head of water long enough for the concrete to cure.

"All this time laborers were shoveling ashes over the upstream side only because something had to be done. The super's hope that some of the fine ashes would be drawn into the crack while settling toward the bottom wasn't fulfilled. About that time I was laid off with a few newer comers. That was tough because I still needed a bank roll to get me to the East coast.

"On my last morning, I saw a deep-sea diver climbing into his suit atop the dam. The new super and some top brass watched. That was too much for me, so I barged into that gang. With that kind of audience, I knew I could get someone to call my bluff, so I said as politely as I could:

"'You guys are supposed to be the brain trust around here. But you haven't half the brains the little Dutch kid had who stuck his finger into the dyke. I can stop that leak and I don't need all this fancy metal and rubber haberdashery. Not only that, but I think I can do it with a few pieces of pipe fittings, a little cement, and have it fin-

Cut out
WASTED TIME AND MONEY



...just push a button
and leave the rest to

Limitorque

Automatic Valve Controls

Think of the time, labor and money that can be saved by opening and closing valves in remote, inaccessible or distant locations with LimiTorque Valve Controls.

LimiTorque not only operates valves at the speed required, but it "limits the torque" applied to the valve operating parts and thus prevents damage to stems, seats, discs or gates . . . and too, the handwheel "cannot rotate" when the valve is being motor-operated.

Send for Catalog L-550.

PHILADELPHIA GEAR WORKS
INCORPORATED

ERIE AVE. AND G ST., PHILADELPHIA 34, PA.

NEW YORK • PITTSBURGH • CHICAGO • HOUSTON • LYNCHBURG, VA.
BALTIMORE • CLEVELAND

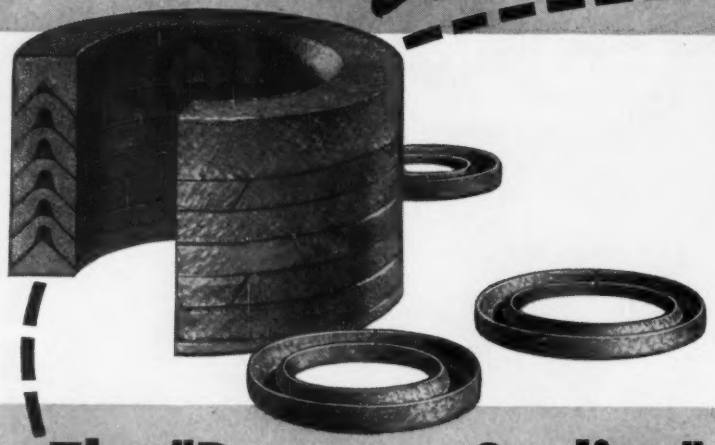
LimiTorque Corporation—Philadelphia

Industrial Gears & Speed Reducers • LimiTorque Valve Controls

Established 1892

BELMONT

BEL-VEE



The "Pressure-Sealing" V-Ring Packing

SEATS AUTOMATICALLY

•

KEEPS EQUIPMENT RUNNING SMOOTHLY. CUTS MAINTENANCE

•

BASIC MATERIAL COMBINATIONS FOR VARIOUS SERVICES

•

A SIZE FOR EVERY ROD & STUFFING BOX

Scientifically designed to make the pressure seal itself, BEL-VEE Rings expand toward the rod and stuffing box wall, on the power stroke or with increased pressure, to automatically form the pressure seal.

On the return stroke, or with pressure relaxed, BEL-VEE Rings contract from the rod for free movement with minimum friction.

BEL-VEE Rings are individually molded in a number of basic material combinations. Offered in sets for pressures to 6000 psi. for sealing reciprocating rods of pumps, engines, compressors, hydraulic equipment and valve stems—handling water, oil, solvents, steam, air and gas.

BEL-VEE Rings are made in practically every rod and stuffing box size. Ask the U.S.G.-Belmont Distributor nearest you or write for Belmont Bulletin No. 4R10.

THE BELMONT PACKING & RUBBER COMPANY
Butler & Sepviva Streets
Philadelphia 37, Pennsylvania

U.S. GASKET • BELMONT PACKING

MARMADUKE

Continued from page 190

ished by tomorrow evening if you give me a helper.'

"That stopped the show. The super looked at me and yelled, 'When I need a tramp engineer's advice, I'll ask for it, Mr Wisenheimer.' But before he could say more, one of the big shots jumped at my offer like a bar fly at a free drink. 'Wait a minute, Mr Casewell,' he advised. 'If this man says he can do it, why not give him a chance? It'll save time and be much cheaper than paying for this diver. Hell's bells, what we got to lose? We've been getting gray hairs for a month because of this damn leak.'

" 'That's right,' chimed in another brain. 'This diver is costing us $25 an hour, and he might be on the job all year.'

" 'OK,' said the super, seeing he was outnumbered. 'Go tell the timekeeper to put you back on the payroll. Then come back and do your stuff and—.'

" 'Not so fast,' I cut in. 'I'm not doing this for peanuts. I need 300 shiny silver dollars to get me to the East coast so I can grab a ship for the Mediterranean. For that kind of money I'll stop this leak completely or you owe me nothing.'

" 'It's a deal,' cut in the same big shot again before the super could open his yap. So we all went down into the machinery room.

"Soon as the diver climbed out of his suit, word spread like news about a free clambake that some screwball was going to stop the leak by next evening. That started all kinds of rumors —guessing just what I'd do.

"I told my helper to get a small air hammer and some long-star drills. Then I examined the crack carefully. It started in the wall's center near the floor and ended in one corner of the ceiling. Looked like a crooked ship's mast with a starboard list. Most of the water came from the crack's crooked part.

"Driving a long, soft wooden wedge into the hole sent the water squirting out along the crack for about a foot on either side of the hole. That told me what I wanted to know.

"My helper and I enlarged the hole to a foot in depth. Then we channeled the crack from floor to ceiling. The channel we cut was 1 in. wide and 6 in. deep. Next, we enlarged the original hole to about 6 in. in diameter at the wall's surface, tapering it to 2 in. at the root. That gave us a funnel-shaped hole about a foot deep.

"I got a 2-in. diameter pipe about 9 in. long, white-leaded the threads and screwed a coupling on one end tightly

How B&W Hollow Forgings Solve Engineering and Production Problems

- The Engineer can specify materials closer to the most desirable design requirements because of the large range of sizes and materials offered in B&W Hollow Forgings.
- The problem of maintaining production schedules is made easier due to good delivery on both large and small quantities.
- B&W Hollow Forgings of the specified analysis produced from initial electric furnace melting under carefully controlled conditions are high-quality forgings that —in use—mean savings in time and cost.
- Because the outside surface of every B&W Hollow Forging is machined, the surface finish and appearance are superior and the user's fabrication cost is sharply reduced.
- Special design requirements can be met; special shapes, special end preparations such as end closures, reduced diameter, flanges and the like.
- To get the *complete* picture of what B&W Hollow Forgings offer you, send for the new B&W Hollow Forgings Bulletin, S-16B. The Babcock & Wilcox Company, Process Equipment Department, Barberton, Ohio.

BABCOCK & WILCOX

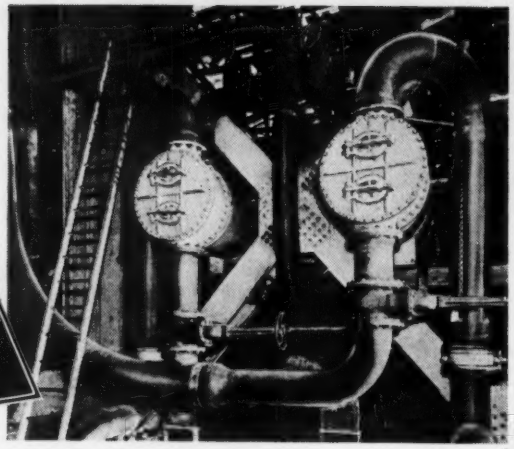
BOILER DIVISION

S-449

CONSECO EQUIPMENT

performs better... costs less to maintain

Conseco Condensate Coolers for hydrogen cooling installation in large utility. Note quick-opening doors for tube sheet inspection. Units are two-pass channel type. Courtesy Public Service Electric and Gas Co.



why?

Our Maintenance Division has taught us the weak spots

. . . of practically all other makes of condensers, heat exchangers, pressure vessels, steam jet air ejectors, and other power and processing equipment. This experience in repairing, rebuilding, and modernization is applied by our Manufacturing Division in the design and production of Conseco Equipment.

WE KNOW, as is possible in no other way, where troubles develop —and Conseco Engineering forestalls them. Only Conseco offers you this advantage, and the dependability and economy which it assures. State your requirements, and we'll send you informative bulletins.

CONDENSER SERVICE & ENGINEERING CO., INC. CONSECO

Designers and Builders of Equipment for Power, Refining, Chemical and Marine Industries

164 Observer Highway
Hoboken, N. J.

EQUIPMENT DESIGNED AND BUILT BY CONSECO

Conseco and its subsidiaries design, build, and install power and processing equipment and accessories, some of which are listed here. Purchasers of Conseco equipment benefit from our maintenance division's quarter century experience in rebuilding, modernizing, and maintaining our own as well as competitors' equipment. This coordination assures easy accessibility for maintenance and low operating cost. Send for bulletins covering equipment in which you are interested.

HEAT EXCHANGERS
CONDENSERS
EVAPORATORS
STEAM JET AIR EJECTORS
STEAM GENERATORS
PRESSURE VESSELS
CENTRIFUGES
FILTERS and STRAINERS
PUMPS, INSTRUMENTS, SPECIALTIES

MARMADUKE

Continued from page 192

with a pipe wrench. Then I wrapped plumber's twine around the threads on the other end until that end looked like a tennis ball made of string. I now had a piece of pipe with a coupling on one end and a string ball on the other. I screwed a 6-in.-long nipple into the coupling hand tight and placed the pipe's stringed end into the tapered hole. Then I drove it into the hole with a hammer. Now all the water was coming out of the pipe.

"Next, my helper and I calked about an inch of oakum into the bottom of the 6-in.-deep channel that followed the crack from floor to ceiling. After that we mixed some rich grout and filled the channel flush with the wall on either side of the pipe. Then we filled in the hole around the pipe until it buried most of the coupling. That left the loose nipple free so it could be removed. The loose nipple stuck out of the wall and all the water shot out of it while the grout was drying. I fastened a hose to the nipple's end to carry the water down the drain.

"'That's all until tomorrow morning,' I announced to my audience and shoved off. They could see that I had a passage for the water to run out so the wet grout could dry.

"Next morning when I showed up I had a bigger audience. And the grout was dry. First I removed the hose, then unscrewed the loose nipple that was sticking out of the wall. Then I borrowed a socket wrench and screwed a white-leaded pipe plug into the coupling in place of the nipple. That stopped the water completely.

"I mixed a little grout and slapped it into the hole, covering up the plug flush with the wall. I knew no one could tell it from the rest of the wall after the cement dried. Just about then the super barged in with his gang of top brass. They looked at the wall where it had leaked the night before. But all they could see was a little wet cement. They examined the rest of the crack, but there was no sign of moisture.

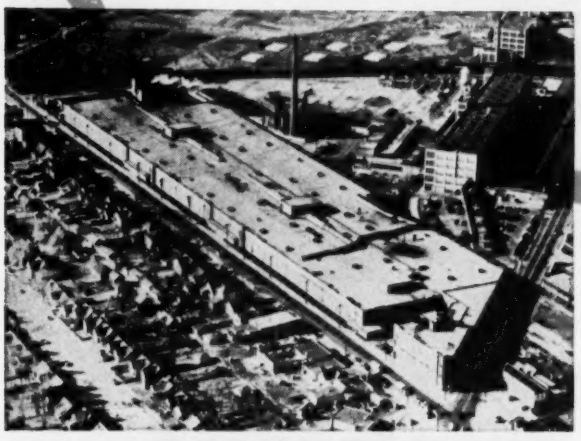
"'You win,' said the super, scribbling a note. 'Take this to the paymaster and get your 300 dollars.'

"'And thanks for pulling us out of a hole, Chief,' said the big shot who had given me the green light. 'You taught us all a lesson we'll remember,' he continued. 'Any time you want a job around here, just let us know. Always glad to see you.'

"I shook hands all around and headed for the railroad tracks up the valley. Just then I heard the whistle of a

7 DETROIT STOKERS

in two *Eli Lilly and Company plants*

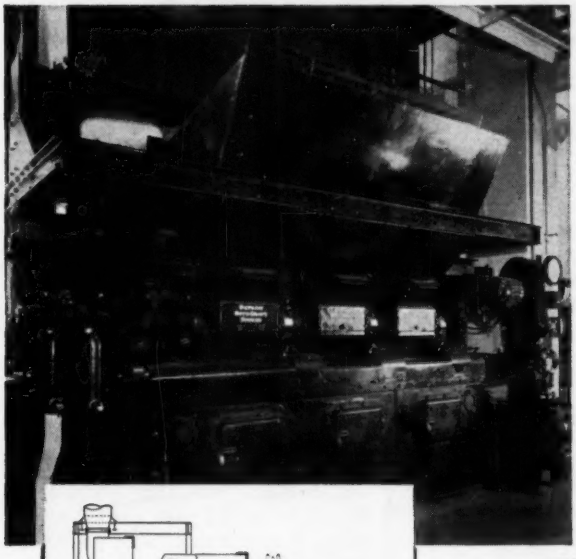


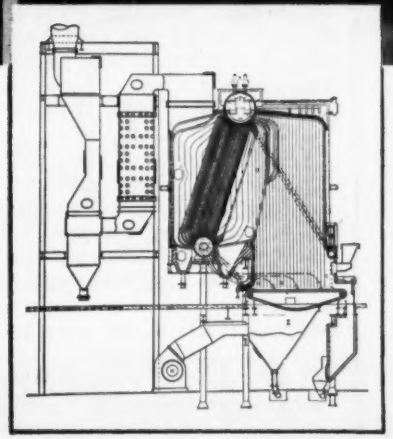
FOUR CONTRACTS

High efficiency with low maintenance—ability to handle rapidly fluctuating loads, and cleanliness are Detroit Stoker features that appealed to Eli Lilly and Company engineers.

Cleanliness—elimination of sources of possible contamination—is of paramount importance to plants making thousands of medicinal products having the highest reputation for purity.

At the left one of the two Detroit RotoGrate Stokers at the Lilly Indianapolis plant. Capacity each Babcock and Wilcox unit 75,000 pounds per hour. RotoGrates also are in service at their new Tippecanoe Laboratories, Lafayette, Indiana.





Write for Catalog—
No Obligation.

DETROIT *SINCE 1898* **STOKERS**

DETROIT STOKER COMPANY

GENERAL MOTORS BLDG., DETROIT 2, MICH.

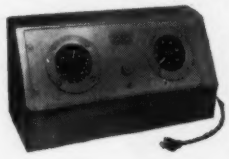
District offices in Principal Cities • Works in Monroe, Mich.

Bendix-Friez

AEROVANE* SYSTEM

TRANSMITTER

RECORDER



INDICATOR

CONTROLLER (Windtrol†)

...helps solve air pollution problems

Chances are, the Bendix-Friez* Aerovane System can be a big help to you in offsetting air pollution problems. For example, if wind speed and direction are an important factor in your problem, here's one way the Aerovane System can help. When wind speed reaches a pre-set value and wind direction falls within an undesirable sector, the Aerovane controller will automatically actuate operating equipment such as fans, blowers, heaters, etc. The entire system can be used in dozens of plant applications. Or, any one of the units can be purchased for use with the transmitter.

TRANSMITTER—Detects wind speed and direction. Electrically sends information to indicator, recorder and controller.

RECORDER—Inks the wind speed and direction on time calibrated chart. Has three speeds for 1½-, 3- or 6-inches per hour. Under normal 3-inch-per-hour setting, recorder operates continuously for two-week period.

INDICATOR—Shows wind speed and direction. Illuminated dials, white over black markings for maximum legibility. Calibrated in degrees of compass and miles per hour.

CONTROLLER—Actuates circuits, turns on alarm system, operates other equipment when wind speed and direction reach pre-determined settings. Wind speed and wind direction dials mounted on face. Automatic time delay device compensates for fluctuating wind direction and speed. Time length is adjustable.

Write today for complete information. *Reg. U. S. Pat. Off. †Trade-mark

Bendix - Friez

FRIEZ INSTRUMENT DIVISION • BENDIX AVIATION CORPORATION

1461 TAYLOR AVENUE BALTIMORE 4, MARYLAND

Export Sales and Service: Bendix International Division, 205 E. 42nd Street, New York 17, N. Y., U.S.A.

MARMADUKE

Continued from page 194

freighter rattling across the mountains. Before long I was taking in God's grand mountain scenery from a box car's sun deck as she highballed East over the wide open spaces. With three hundred dollars anchored safely in my pocket, I was riding high. Man, that was really living!"—*SME*

Marmy's Mailbox

'Tis here you exchange blasts with the old boy

GUNNY-SACK TEST

I ran into Marmaduke Surfaceblow in 1910. I had just received my stationary engineer's license in Ohio and had a job with a steel-construction firm. We had three small upright boilers operating a 2-drum hoist for raising steel.

Taking over the watch, I couldn't see water in No. 1 boiler. So I banked the fire and the steam pressure dropped. The boss came storming over to the boiler and flipped his lid. I told him I didn't know where the water was in the boiler. That's when a big husky foreman came by. He was wearing an old grey bowler, just like Marmy, and looked like him. He grabbed a gunny sack, poured water on it and held it against the drum. The water dried an instant sooner on the steel opposite the water than opposite the steam. "There's your water level," he roared. Boy, did I feel silly.

New York, N. Y. P WILSON

ENJOYS HUMAN INTEREST

I especially enjoyed Marmaduke last month when I was laid up with an operation. While lying on my tummy I had some delightful moments ironing out problems with Mr Surfaceblow. I'm now getting our engineers and others to read him so they'll put a little human interest in the reports they write.

Chicago, Ill. D HEATON

A REAL ENGINEER

I have been in the boiler business 35 years, both repairing and manufacturing. Marmy's story, "Foolproof boilers aren't for fools" in March, is believable. I've even seen much worse happenings. We ran into many dangerous conditions back in the days before Connecticut had boiler laws and inspection. Marmy is always amusing and must be a real engineer.

E H MCCATHRON, *President*
McCathron Boiler Works Co

Inside story:

Valves may look alike on the surface. Their performance is another story. And the inside story of Powell Valves is that *every* Powell Valve has *Performance Verified.*

X-ray and gamma ray inspection—examining the very structure of the metal itself—are two of the many ways that Powell can make absolutely certain that Powell Valves will give *dependable* flow control.

Every part of every valve must pass rigid inspection. As a final step in manufacture, every Powell Valve is subjected to *an actual line test.* Because of Powell's pains-taking quality control, valve repair is cut to the minimum and plant shut down through valve failure is substantially reduced. Records from refineries, power and industrial plants the world over prove it.

Consult your Powell Valve distributor. If none is near you, we'll be pleased to tell you about our COMPLETE *quality line* which has PERFORMANCE VERIFIED.

The Wm. Powell Company, Cincinnati 22, Ohio . . . 110th YEAR

PERFORMANCE PV VERIFIED

FIG. 19003 WE—900-Pound Steel Pressure Seal Gate Valve.

FIG. 11365 WE—Steel Pressure Seal Horizontal Lift Check Valve for 1500 Pounds W.S.P.

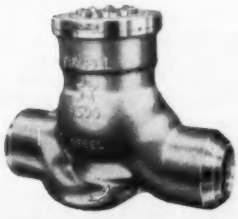


FIG. 3031 WE—Steel Globe Valve for 300 Pounds W.S.P.

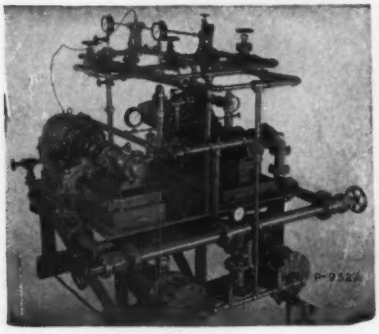
POWELL VALVES

BRONZE, IRON, STEEL AND CORROSION RESISTANT VALVES.

NATIONAL AIROIL

SERVING INDUSTRY'S COMBUSTION REQUIREMENTS FOR 43 YEARS

NATIONAL AIROIL
FUEL OIL PUMPING and HEATING UNITS



P-952A—Steam Turbine and Electric Motor drive gives flexibility in this compact Model P-ES2H size No. 25 unit.

Complete range of sizes and models in both medium and high pressure types . . . *more compact than ever!* Write for Bulletin 40.

NATIONAL AIROIL
COMBUSTION ACCESSORIES

AIR CONTROL DOOR and FRAME

FUEL-OIL SUCTION STRAINER

WIDE VIEW PEEPHOLE

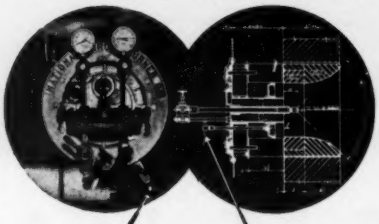
IGNITION PORT

FURNACE RELIEF and ACCESS DOOR

FUEL-OIL HEATER

These and other "accessory items" for every industrial liquid fuel-gas installation. Ask for Brochure No. 10.

NATIONAL AIROIL
UNIVERSAL REGISTERS with TYPE "SA" OIL BURNERS



Control for Air Vane

Control for Refractory Faced Disk

BETTER PERFORMANCE with NATIONAL AIROIL Universal Registers because they have a DUAL FEATURE for controlling air volume independent of turbulence. Air vanes can be instantly reversed to change direction of turbulence while air volume is separately regulated by a refractory faced disc control. Both adjustments can be made while the burner is firing.

Another "dual advantage" of NATIONAL AIROIL Universal Registers is that they are equipped for dual fuel firing of gas and oil. Universal Registers with burners are available in three (3) sizes . . . capacities up to 60,000 lbs. of steam produced per burner per hour. Write for Bulletin 51.

OIL BURNERS and GAS BURNERS for industrial power, process and heating purposes
STEAM ATOMIZING OIL BURNERS
SLUDGE BURNERS, Steam Atomizing
MOTOR-DRIVEN ROTARY OIL BURNERS
MECHANICAL PRESSURE ATOMIZING OIL BURNERS
DUAL STAGE, Combining Steam and Mechanical Atomization
LOW AIR PRESSURE OIL BURNERS
AUTOMATIC OIL BURNERS, for small process furnaces and heating plants
GAS BURNERS
COMBINATION GAS & OIL BURNERS
FUEL OIL PUMPING and HEATING UNITS
FURNACE RELIEF DOORS
OBSERVATION PORTS
SPECIAL REFRACTORY SHAPES

NATIONAL AIROIL BURNER CO., INC.

1250 EAST SEDGLEY AVE., PHILADELPHIA 34, PA.
Southwestern Division: 2512 South Boulevard, Houston 6, Texas

INDUSTRIAL OIL BURNERS, GAS BURNERS, FURNACE EQUIPMENT

BOILER OPERATION

Continued from page 99

per shift. Check all auxiliaries for lubrication, normal bearing temperatures, freedom from vibration, etc.

Observe evenness of fuel-air distribution, and note slag and ash accumulations. Remove slag and ash from all parts of boiler and dust collector. Do this as often as needed, usually at least once a shift. Follow directions on blowing down the boiler and adding feedtreatment chemicals.

A general inspection once each shift is necessary. Check for leaks, abnormal expansion, hot spots, unusual noise or vibration. If you find anything out of order, report it promptly or correct it.

Aside from this, there is little to do except keep steam generation equal to steam demand, so you maintain steady pressure. Also, keep waterwalls cleaned, burners adjusted, and attemperators or control dampers, used to maintain desired steam temperature, set so this temperature stays within safe limits.

If fuel or air supply limits boiler output, or steam demand is excessive, cut off some load. This is better than letting steam pressure drop so much that boiler has to withstand heavy temperature strains, and auxiliary operation is affected.

If wet coal, low gas pressure or other trouble causes unsteady fires, use ignition torches to assure stability. If fires are lost, curtail load promptly. Then pressure will not drop excessively before boiler can be properly purged and burners relighted.

If you lose the load, keep combustion control on AUTOMATIC, assuming that it has a low-load limit. Let the boiler pop until you know definitely that load will not be suddenly reapplied. After several minutes, you can more accurately establish steam-demand conditions. Then cut fires and stop boiler popping to conserve water and heat, if that appears desirable. When there is a reheater that does not have a means for maintaining flow of cooling steam, you may have to kill fires quickly if load is lost.

Every week or two, operators on each shift should practice transferring auxiliaries and going from automatic to manual control and back. Then in case of trouble they will be ready for necessary transfers and operations.

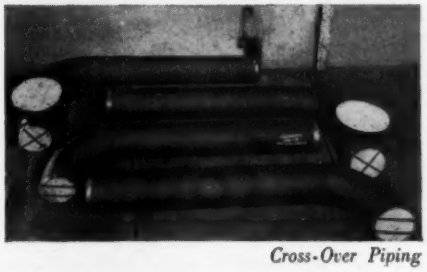
BOILER SHUTDOWN

When a boiler is to be taken out of service for repairs, blow the soot before reducing rating. In dropping load, you can usually stay on automatic control until you have to take burners out of service to keep a stable flame. Leave feedwater regulator in service as long

Manual metallic-arc field welding. Electric coils, wound around areas adjacent to weld, are used in preheating, and in local stress relieving after completion of weld.

Main Steam Piping

Hot Reheat Piping



Cross-Over Piping

Shop fabricated assemblies above are produced to sizes which installation and shipping facilities permit.

FIELD ERECTION by P.P.&E.

Assures Safe, Efficient Operation of HIGH TEMPERATURE, HIGH PRESSURE PIPING

Pittsburgh Piping and Equipment Company was among the first to recognize the importance of complete piping fabricating service, including the responsibility for erection of the piping system.

At P.P.&E. sub-assembles are shop fabricated in sections as large as shipping facilities and installation area permits, are checked for dimensional alignment, and delivered ready for accurate erection. Field welds are planned for maximum accessibility. Consequently, erection by skilled, specially trained craftsmen is facilitated.

An experienced P.P.&E. field organization handles all erection problems, and coordinates field work with shop fabrication so that materials arrive on schedule, and in the sequence which permits erection to proceed rapidly and efficiently.

PRODUCTS AND SERVICES

Carbon Steel Piping	Forged Piping Materials
Cast Iron Fittings	Headers
Cast Steel Fittings	Manifolds
Chrome-Moly Piping	Pipe Bends
Copper Piping	Stainless Steel Piping
Corrugated Piping	Van Stoning
Creased Bends	Welded Assemblies
Expansion Bends	Welded Stainless Steel Tubing
Flanges	Welding Fittings

PP-15

Pittsburgh Piping AND EQUIPMENT COMPANY
158 49th Street — Pittsburgh, Penna.
CANADA: CANADIAN PITTSBURGH PIPING, LTD.
835 BEACH ROAD—HAMILTON, ONTARIO

OFFICES IN PRINCIPAL CITIES

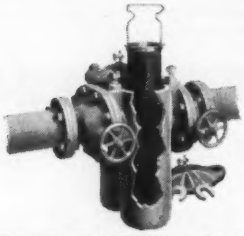
Atlanta	Whitehead Building
Boston	10 High Street
Chicago	Peoples Gas Building
Cleveland	Public Square Building
Houston	Heights State Bank Building
Los Angeles	1830 North Alexandria Ave.
New Orleans	P. O. Box 74
New York	Woolworth Building
Syracuse	113 So. Salina Street
Toronto	68 Yonge Street
Washington	Wire Building

ELLIOTT STRAINERS

DESIGNED TO GET LIQUIDS...

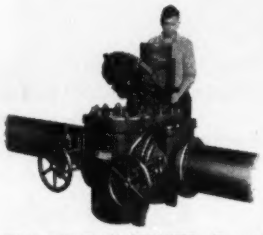
"TROUBLE-FREE" CLEAN

THERE'S NO CHANCE of foreign matter gumming-up your costly liquid-handling equipment when Elliott Strainers are on the job. They have proven an excellent method of removing objectionable solids from water, fuel and lubricating oil, gasoline, and in fact any strainable liquid. Backed by over fifty years of Elliott design and construction experience, these present-day strainers are servicing thousands of power and industrial plants everywhere. The line offers a great variety of types including Single, Twin and Self-Cleaning Strainers, covering pipe sizes with an I. D. of from 1" to 24". For detailed information on any or all of these strainers, call your local Elliott Field Engineer or write Elliott Company, Accessories Dept., Jeannette, Pa.



TYPE "V" TWIN STRAINER—Specially designed for lube oil, fuel oil and viscous liquids. Available sizes 1" to 8" for 125, and 1½" to 10" for 300 and 500 psi. Straining baskets available with 1/64" to 3/16" mesh.

TYPE "K" SELF-CLEANING STRAINER—For removing large amounts of dirt and foreign matter in water only. Available sizes 4" to 24" for pressures from 25 to 125 psi. Straining units available with 1/32" to 3/8" mesh. Can be furnished with AC or DC motor. The power requirement does not exceed ½ hp., in the largest size.



TYPE "A" TWIN STRAINER—For water and other liquids . . . available sizes 4" to 24" for 125 psi—4" to 12" for 250 psi. Straining baskets available with 1/32" to 3/8" mesh. The twin strainer design, with one chamber always available for service, assures clear liquids on a continuous basis.

TYPE "F" SINGLE STRAINER—For use where the flow does not contain large quantities of foreign matter, and where the strainer can be temporarily out of service for cleaning. Available in sizes from 2" to 24". Baskets available with 1/32" to 3/8" mesh. Has a single perforated basket, convenient to handle and quickly accessible.

ELLIOTT Company

AS-1

STEAM TURBINES • MOTORS • GENERATORS • DEAERATING HEATERS • EJECTORS • CONDENSERS • CENTRIFUGAL COMPRESSORS • TURBOCHARGERS • TUBE CLEANERS • STRAINERS

BOILER OPERATION

Continued from page 198

as it holds the water level satisfactorily.

Thin and burn down the stoker fires. Reduce boiler pressure considerably to cut amount of heat that must be dissipated after removing boiler load. Another way to drop boiler pressure: Kill fires a few minutes before taking the turbine-generator off the line. This may cause a large drop in steam temperature, and may be undesirable if carried on for a long period.

If boiler is connected to a steam header, you can leave the stop valve open until fire dies down and no longer produces steam. Add water periodically as needed to keep boiler-water level normal.

Once burners are out, shut off air flow completely unless the boiler is too warm or it is to be cooled down for repairs. In the latter case, you can vent off the steam and open the setting doors, or keep fans running to help cool the unit.

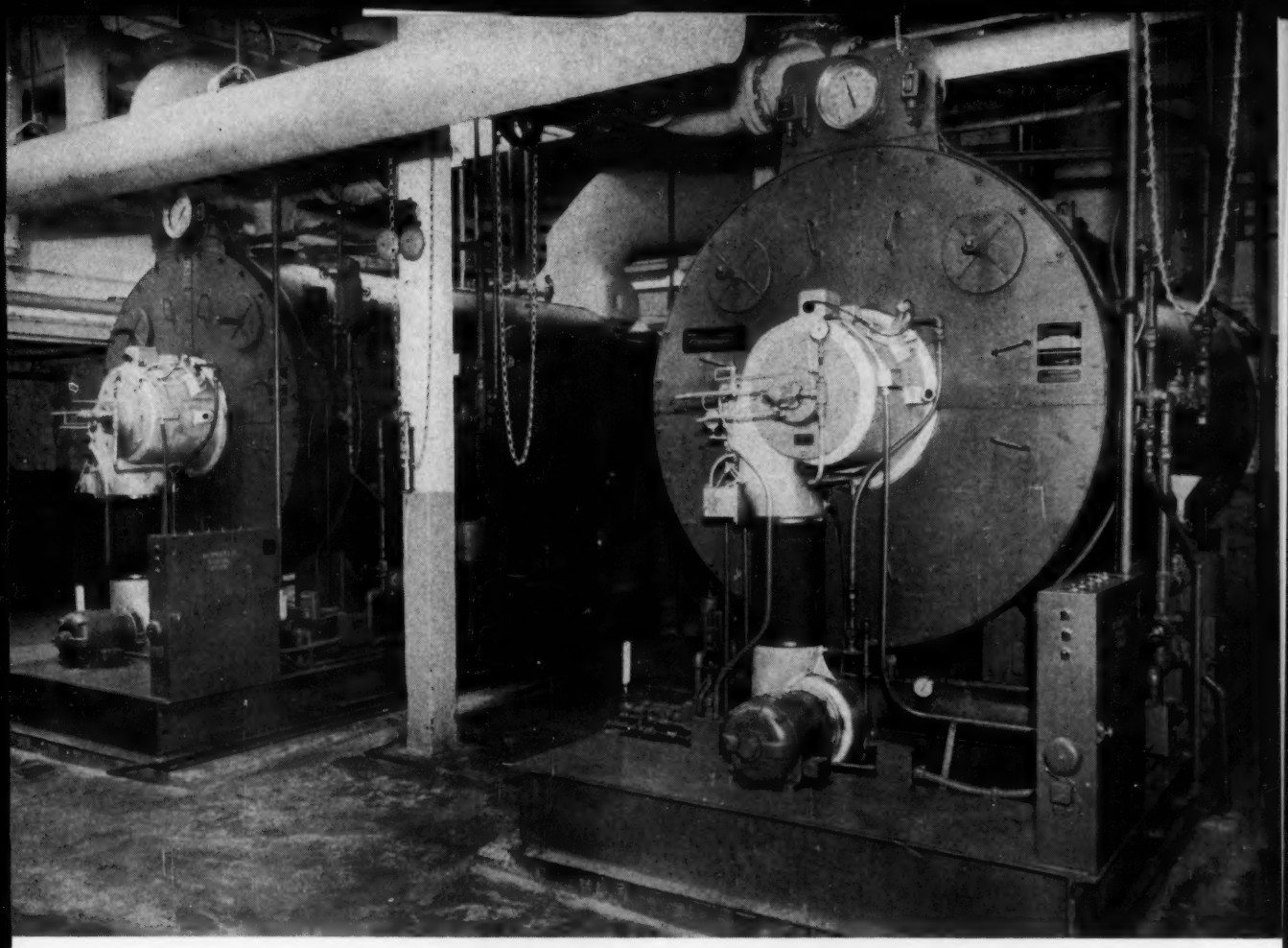
The temperature drop shown by saturated-drum-steam temperature or by exit flue-gas temperature is usually limited to 50 F per hour. Take care to avoid chilling refractory too suddenly, to avoid cracking or spalling. Shut down regenerative air heaters when exit flue gas reaches about 300 F.

Before pressure drops to atmospheric, open a vent or vents to avoid pulling a vacuum on the boiler as it cools further. Gasket leaks may be started by a vacuum that tends to pull handhole or manhole heads in. If you must hasten boiler cooling, drain out the water when pressure is nearly off.

Keep manheads in place, to avoid drying and air-hardening of any deposits on internal surfaces, until the boiler is cool enough to enter. It's undesirable to use cold water for cooling unless you can add it so as to avoid rapid temperature changes in pressure parts. Some engineers use steam or a fine water spray on the gas side of boilers, superheaters and economizers to soften and loosen deposits. Take care to avoid wetting brick work excessively.

If boiler is to be held ready for quick return to service, keep pressure up to or close to header pressure by intermittent firing or by banking a stoker. If return to service is not so imminent, you can let pressure drop further by less frequent firing or by carrying a lighter bank on the stoker.

To lay a boiler up cold, but ready for quick return to service, fill it completely. An expansion tank, above the highest point on the boiler, keeps air out and avoids possibility of oxygen corrosion. If boiler is to be held in this condition for a considerable period, add



$9,040 Saving in Steam Cost

WITH *Powermaster*® PACKAGED AUTOMATIC BOILERS

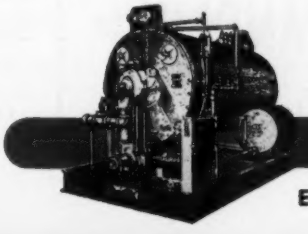
You get MORE than low-cost steam with Powermasters:

- ★ Low-cost, space-saving installation
- ★ Fast steaming
- ★ Instant response to load changes
- ★ Quick fuel change-overs
- ★ Clean, dry steam
- ★ Automatic operating and safety controls
- ★ High fuel economy at all loads
- ★ Clean, quiet operation
- ★ Smokeless combustion
- ★ One-source responsibility for complete unit
- ★ Nation-wide factory-trained service organization
- ★ Pay-As-You-SAVE Purchase Plan

These two 200 HP *Powermaster* Packaged Automatic Boilers are saving 50% of steam costs annually for a large manufacturer of clothing. In addition, they are providing hotter, drier steam for processing and comfort heating.

Completely factory assembled and fire-tested *Powermasters* have gained world-wide acceptance as dependable producers of low-cost steam or hot water. And now, you can put a *Powermaster* in your plant or building on the Pay-As-You-SAVE Purchase Plan, that helps you pay for your new boiler out of its own savings.

Write for Bulletin 1220, or ask our representative to explain why it pays to modernize with *Powermaster*.



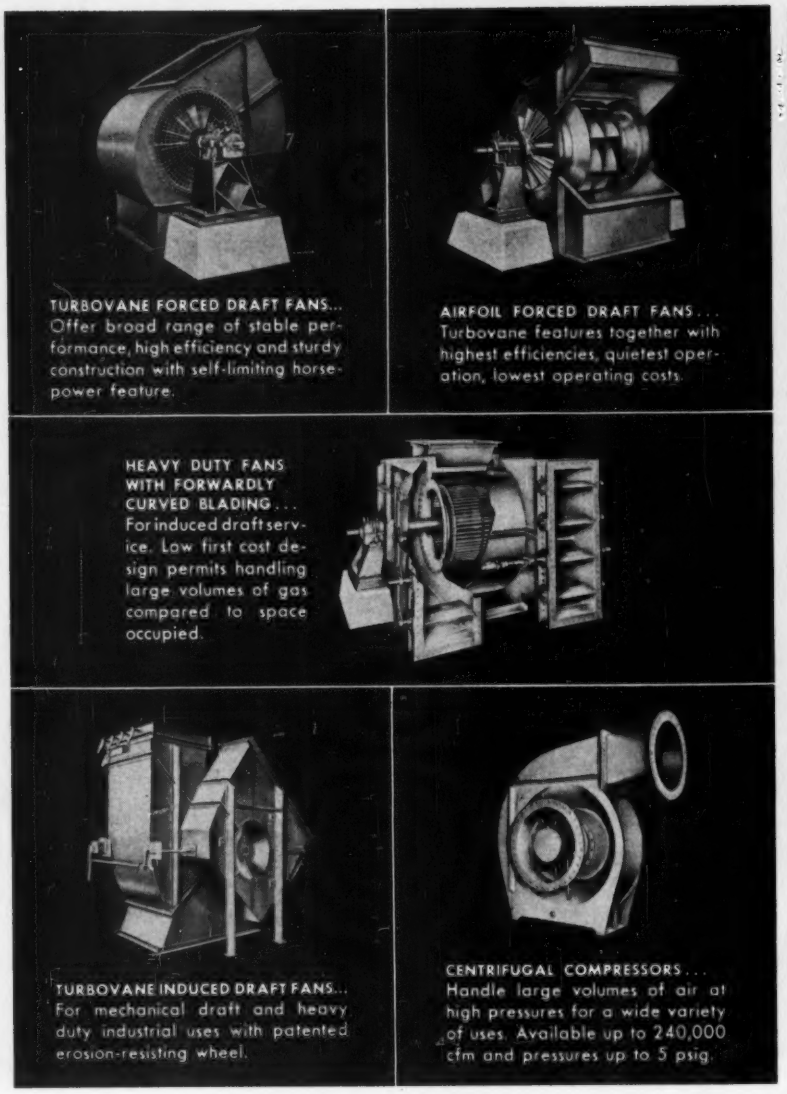
Powermaster®

PACKAGED AUTOMATIC BOILERS

In sizes to 500 HP; pressures to 250 psi.

ORR & SEMBOWER, INC.

Established 1885 • Morgantown Road, Reading, Pa.


TURBOVANE FORCED DRAFT FANS... Offer broad range of stable performance, high efficiency and sturdy construction with self-limiting horsepower feature.
AIRFOIL FORCED DRAFT FANS... Turbovane features together with highest efficiencies, quietest operation, lowest operating costs.
HEAVY DUTY FANS WITH FORWARDLY CURVED BLADING... For induced draft service. Low first cost design permits handling large volumes of gas compared to space occupied.
TURBOVANE INDUCED DRAFT FANS... For mechanical draft and heavy duty industrial uses with patented erosion-resisting wheel.
CENTRIFUGAL COMPRESSORS... Handle large volumes of air at high pressures for a wide variety of uses. Available up to 240,000 cfm and pressures up to 5 psig.

A Complete Line of Forced and Induced Draft Fans for Utility and Industrial Power Generation

These and many other designs available for:

- ★ **primary and secondary forced draft**
- ★ **induced draft**
- ★ **gas recirculation**

Complete engineering application service by Westinghouse-Sturtevant is available to you to solve any mechanical draft problem. Call our Sales Engineer, or write Westinghouse Electric Corporation, Sturtevant Division, Hyde Park, Boston 36, Mass.

WESTINGHOUSE AIR HANDLING

YOU CAN BE SURE...IF IT'S Westinghouse

J-80453

BOILER OPERATION

Continued from page 200

sodium hydroxide to bring pH up to about 10.5, and add sodium sulfite to provide a reserve of 20 to 30 ppm to absorb oxygen.

If a boiler is to be out of service for a long time, drain it and thoroughly wash down internally. Dry out water pockets in headers and elsewhere and, if possible, blow superheaters clear of water. Quicklime in trays placed in the drums absorbs excess moisture in the air inside the boiler. Keep boiler openings closed so moist outside air stays out.

Prevent air flow through the boiler. Condensation often occurs with sudden temperature changes as the boiler metal cools warm moist air. Give finished parts on boiler auxiliaries a good coat of oil or grease to prevent rusting. Provide motors with small heaters to prevent winding deterioration from moisture absorption.

CLOSED FEED CYCLES

Continued from page 89

connection to each of two heaters, lock one valve in the open position. This valve can be closed when the proper one is opened, a few minutes after the standby pump starts.

To simplify the piping and reduce the number of valves, balancing-device leakoff can be manifolded with the recirculation line. The combined pipe is then branched to the two heaters.

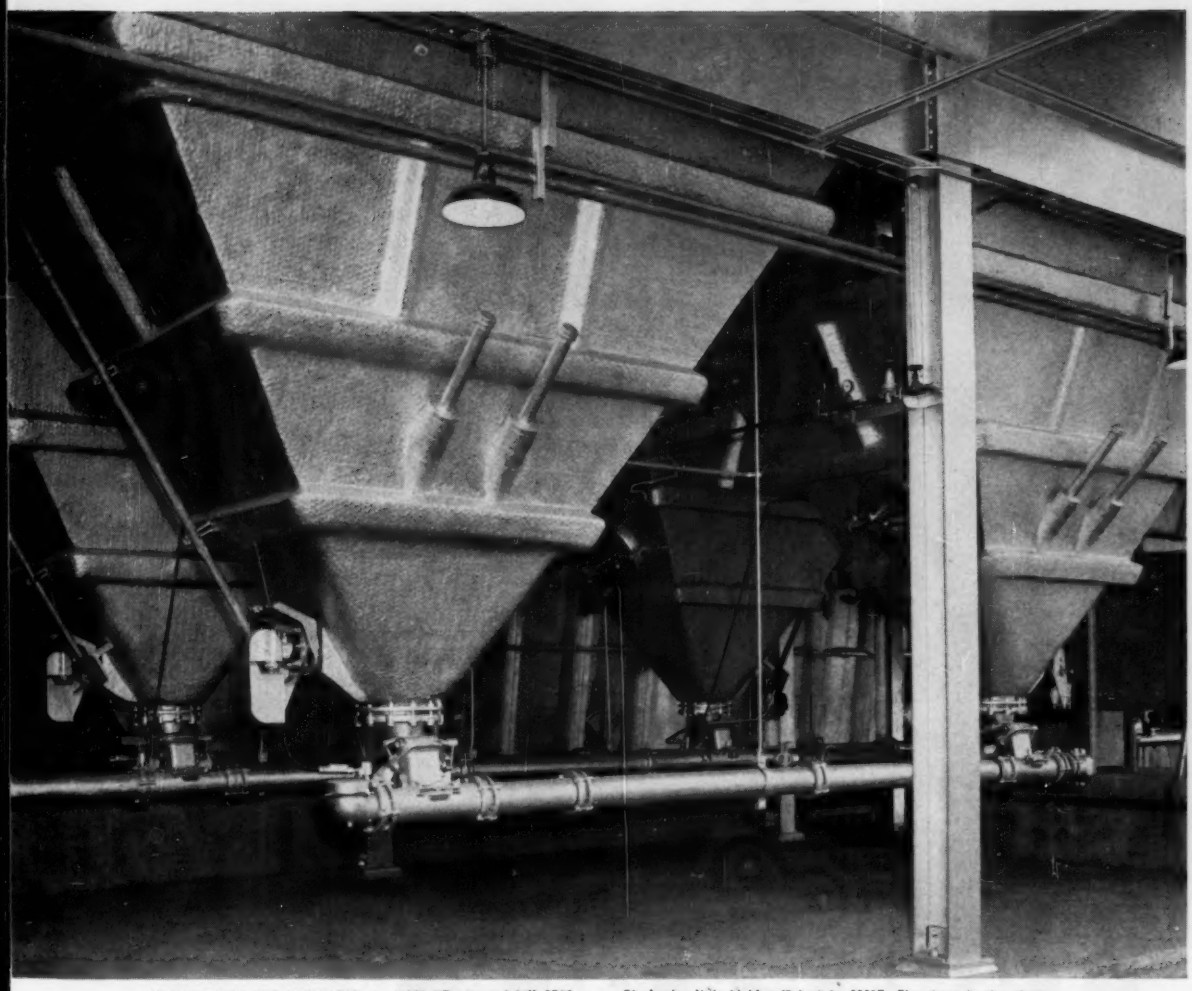
Another solution to this problem is to pass both the recirculation and balancing-device leakoff back to the pump suction, after the combined flow has been cooled in a heat exchanger.

Pump temperature. To keep the standby pump at the temperature of the pump or pumps on the line, two arrangements can be used. (1) A warm-up valve is located on the pump casing, leading to some point in the feed cycle where the pressure is appreciably lower than in the heater. Warm-up flow takes place from the heater, past the open suction valve, through the pump and out through the warm-up valve.

(2) A jumper line is installed around the pump check valve, Fig. 4. Warm-up flow is from the discharge header, through the pressure-reducing orifice and pump, and out into the suction header to the pumps on the line. This system should be fitted with a relief valve because there is a possibility that both suction valves may be closed at the same time.

In the closed cycle, the balancing-

(*Continued on page* 213)



HEAT LOSSES ARE MINIMIZED by K&M "Featherweight" 85% Magnesia insulation on these fly-ash hoppers at the Meramec Power Plant of the Union Electric Company of Missouri, St. Louis. It is highly efficient to 600°F. Elsewhere in the plant, "Featherweight" is applied in combination with K&M Hy-Temp for efficiency to 1900°F. Insulation contractor: Armstrong Cork Company.

Keep steam hotter–longer–at less cost– with K&M thermal insulations

K&M insulations give you highly efficient, cost-cutting insulation in every service temperature range. Whether used for maximum conservation of heat, protection of personnel, or control of room temperature, these insulations have proved their effectiveness through more than 65 years of use. K&M "Featherweight"® 85% Magnesia and K&M Hy-Temp insulations will serve for the life of your equipment. For efficiency to 1900° F., they are applied in combination, with staggered joints. This eliminates the heat loss that normally occurs in single-layer installations when expansion causes joints to open. Where severe water exposure or high humidity may be a problem, K&M "Featherweight" Water-Resistant Magnesia insulation is especially effective to 450° F.

Your K&M Distributor—who is an experienced applicator—will be glad to give you complete information on K&M thermal insulations. Or, write us.

KEASBEY & MATTISON
COMPANY • AMBLER • PENNSYLVANIA

K&M best in asbestos®

In Canada: Atlas Asbestos Company, Limited; Montreal, Toronto, Winnipeg and Vancouver

TAPER-LOCK

A PATENTED PRODUCT OF DODGE

—OFF THE SHELF

NO REBORING!
NO KEYSEATING!
NO MACHINING!

Ready for the shaft, with no costly, time-consuming operations to make them fit. That's the big news about Dodge Taper-Lock Sprockets. Taper-Lock grips the shaft with the firmness of a shrunk-on fit, yet comes off easily. Bushings may be re-used. They come in sizes to meet most every application.

Taper-Lock Sprockets are available from Distributors' stocks in a complete range of B-type steel sprockets —½" to 2" pitch. Dodge quality Roller Chain is packaged in 10-foot lengths—also available in 50-foot and 100-foot reels. Save time—save money—keep production rolling—get Dodge Taper-Lock Sprockets and Roller Chain from your Dodge Distributor.

DODGE MANUFACTURING CORPORATION, 3200 Union St., Mishawaka, Ind.

CALL THE TRANSMISSIONEER, your local Dodge Distributor, for valuable assistance on new, cost-saving methods. Look for his name under "Power Transmission Machinery" in your classified telephone directory, or write us.

THERE'S ONLY ONE TAPER-LOCK, THE BUSHING THAT MOUNTS FLUSH!

Standardize, economize with Taper-Lock, the bushing that is interchangeable in Dodge sprockets; sheaves, couplings and conveyor pulleys. *More than 2,000,000 in use!*

DODGE

of Mishawaka, Ind.

ENGINEER'S BOOKSHELF

Preventative Maintenance of Electrical Equipment. *By Lt Cmdr Charles L Hubert, Head, Section of Electrical Engineering, U.S. Merchant Marine Academy, Kings Point. 6x9, 214 pp, cloth, illust, $4.00. McGraw-Hill Book Co, Inc, 330 W 42nd St, New York 36, N. Y.*

Preventative maintenance and emergency repairs are the concepts stressed in this book. Presented in simple, concise style is pertinent information needed by operating engineers, maintenance electricians, plant superintendents and engineering students. The material is divided into three sections—making it adaptable for technical, vocational and industrial programs because the instructor can emphasize specific aspects of the book for his course without losing any continuity.

Part I describes preventive maintenance programs for motors, generators, controllers, electronic apparatus, batteries, transformers, fluorescent lights, etc.

Part II treats trouble-shooting methods in detail with emphasis on emergency repairs that will keep equipment in operation until it can be scheduled out of service.

Part III presents correct operating techniques for generators, motors, transformers and controllers as a means of strengthening maintenance programs.

Feature material includes: (1) A comprehensive coverage of electrical insulation. (2) Latest ASA, AIEE and NEMA standards for testing, evaluating and connecting electrical apparatus. (3) Safety precautions for all hazardous operations. (4) Questions and problems that provide a useful learning and teaching aid.

American Standard Safety Code for Elevators, Dumbwaiters and Escalators. *5x7¾, 290 pp, illust, $3.50 for paperbound edition, $4.00 for clothbound edition. The American Society of Mechanical Engineers, 29 W 39th St, New York 18, N. Y.*

This Code is one of a series of safety codes which have been or are being formulated under the general auspices of the American Standards Association. It retains the general form and arrangement of the fourth edition, but has been modified to include many new rules and parts. Each rule is given an appropriate title and number to facilitate indexing. Seven new parts cover electric-hydraulic elevators; power and hand sidewalk elevators; private residence elevators and inclined lifts; inspection and tests of elevators, dumbwaiters and escalators; alterations, repairs and replacements; and design data, formulas and curves. In addition appendix material has been added providing data and information useful in the application of the rules. Definitions have been revised and amplified to correspond with the revision of and additions to the text.

This edition provides a complete compendium on safe design, construction, installation, operation, inspection, testing, maintenance, alteration and repair of vertical transportation equipment of all types. It is intended to serve as a standard reference on safety requirements for guidance of architects, consulting and building engineers, casualty insurance companies, elevator manufacturing, maintenance and repair companies and as a guide for state and municipal authorities in drafting safety regulations.

The Industrial Triangle. *By F H Colvin, editor emeritus, American Machinist. 172 pp, 5½x8½, cloth, $3.50. Columbia Graphs, Columbia, Conn.*

Here is an interesting and lively discussion of industry and the men who work in it. The author brings much experience and sound judgment to his subject, with the result that he has produced a worthwhile contribution to the literature of industry.

Subjects covered include annual wages, labor unions, hiring and firing, collective bargaining, living standard, capital and management, incentives, optimum production, automation, feather bedding, profit sharing, retirement and pension, responsibility, management problems and labor leaders.

Industrial Lubrication Practice. *By Paul D Hobson. 6x9. 549 pp, cloth, illust, $8.00. The Industrial Press, 93 Worth St, New York 13, N. Y.*

Growing interest in the field of industrial lubrication has prompted the writing of several practical books on the subject in recent years. The general approach in most of these books has been to outline the fundamentals of lubrication, consider relationship of the lubricant to system components (such as bearings, gears) and finally, discuss the lubrication of specific machines commonly found in the industrial, marine and central-station plant.

This book follows a somewhat similar structural pattern, although on a more scrutinizing level. There is a reasonable degree of completeness in this work, plus a sound practical approach to plant lubrication that should prove of everyday value to the plant engineer. No attempt is made by the author to discuss the complex mathematical side of the lubrication science—and wisely so. The author has carefully judged the current needs of his prospective audience—the shop superintendent, maintenance engineer, marine engineer, plant engineer, machine designer—and was governed accordingly in his writing.

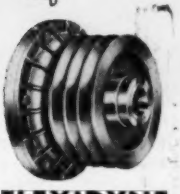
Piping Stress Calculations Simplified. *By S W Spielvogel. 188 pp, illust, 9x11½, spiral binder, $5.00. Published by the author at 15 Old Field Lane, Lake Success, N. Y.*

In the fifth edition of this well-known book the author incorporates the provisions of the 1955 ASA Code for Pressure Piping.

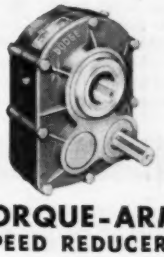
The new Code recognizes the concept of "stress-range" as the criterion for the safety of piping systems. Therefore the problems

(*Continued on page* 210)

DODGE PRODUCTS you should know



FLEXIDYNE
DRIVES & COUPLINGS



TORQUE-ARM
SPEED REDUCERS

DODGE-TIMKEN
PILLOW BLOCKS

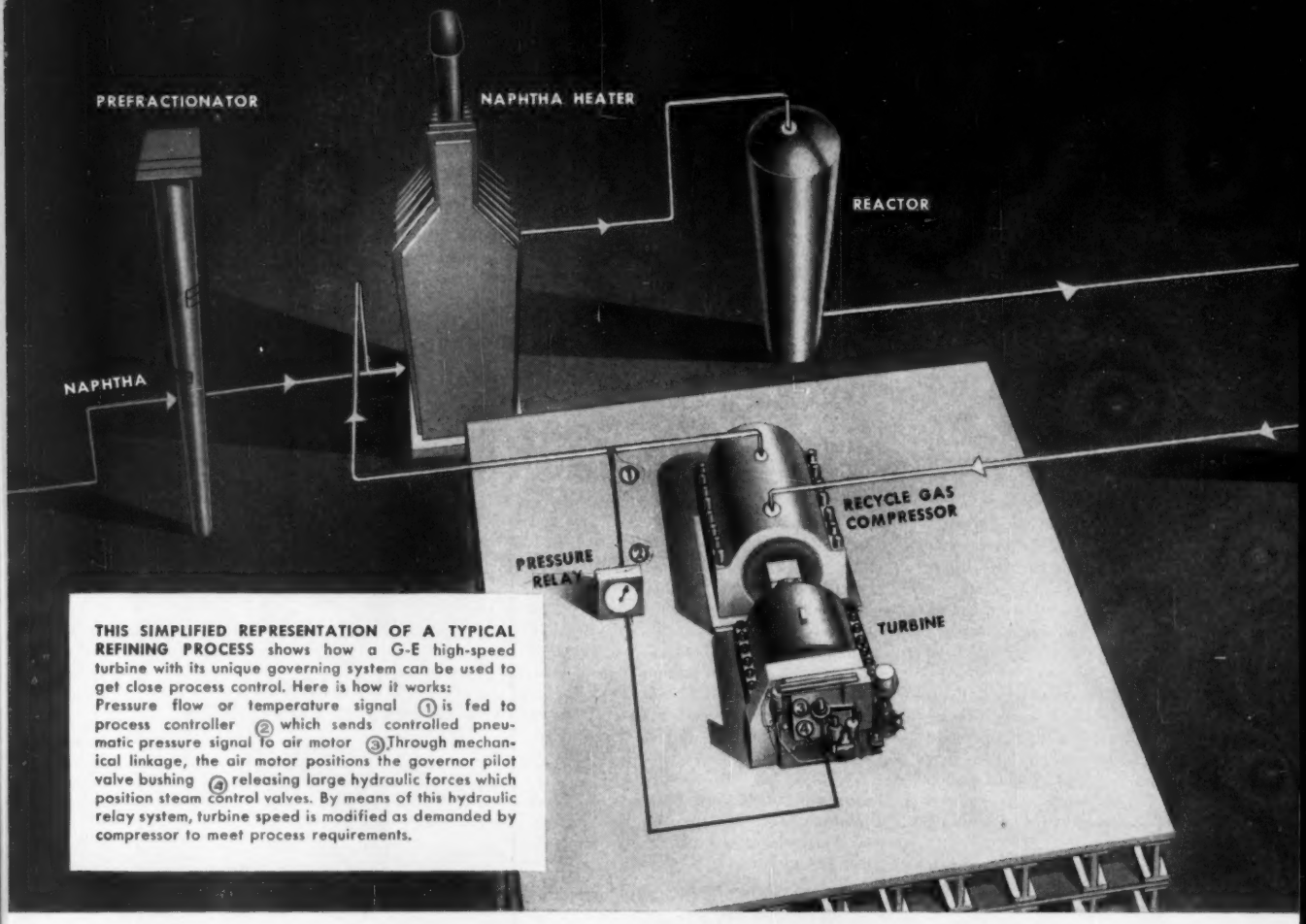
DODGE BULLETINS YOU SHOULD HAVE

- ✓ Flexidyne Dry Fluid Drives and Couplings. Complete story and selection data. Bulletin A-640-A.
- ✓ Torque-Arm Speed Reducers. Technical data and selection methods on all 14 sizes—1 to 60 hp. Bulletin A-637.
- ✓ Rolling Bearings. Load ratings, dimensions and other data on Dodge-Timken and SC and SCM Ball Bearings. Bulletin A-638.

Write for your copies.

DODGE MANUFACTURING CORPORATION
3200 Union Street • Mishawaka, Indiana

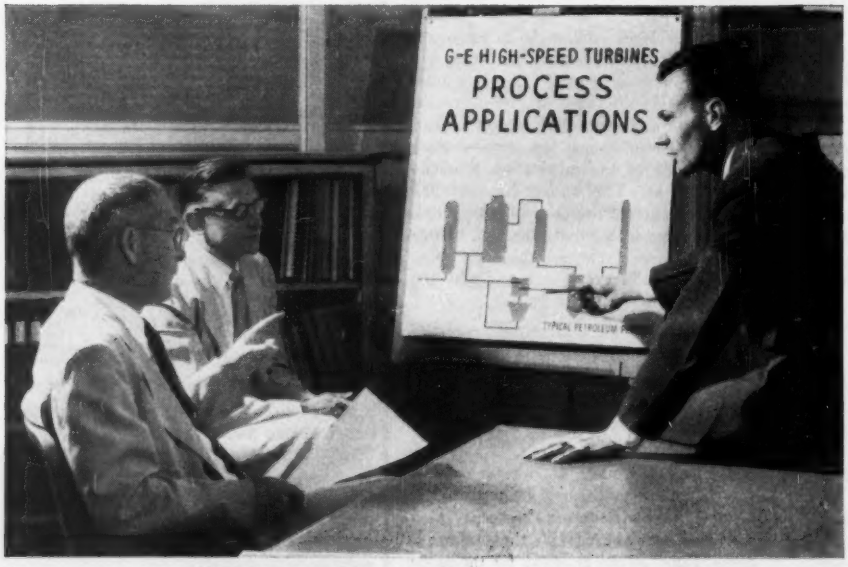
DODGE
of Mishawaka, Ind.



THIS SIMPLIFIED REPRESENTATION OF A TYPICAL REFINING PROCESS shows how a G-E high-speed turbine with its unique governing system can be used to get close process control. Here is how it works: Pressure flow or temperature signal ① is fed to process controller ② which sends controlled pneumatic pressure signal to air motor ③. Through mechanical linkage, the air motor positions the governor pilot valve bushing ④ releasing large hydraulic forces which position steam control valves. By means of this hydraulic relay system, turbine speed is modified as demanded by compressor to meet process requirements.

EASILY INCORPORATED INTO YOUR PRESENT SYSTEM . . .

G-E position-restored turbine governing

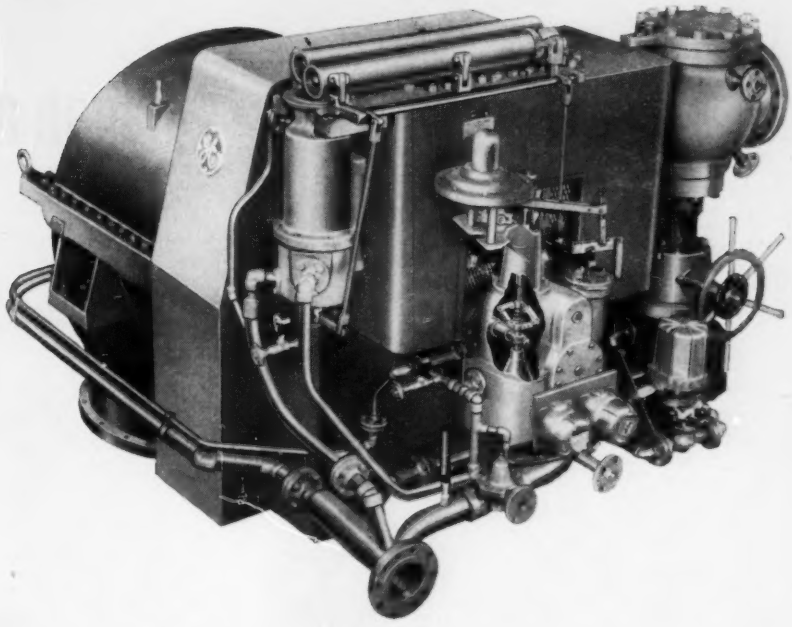


HERE IS THE SMALL TURBINE AND SUPERCHARGER DEPARTMENT MARKETING TEAM that can show you how to apply all the advantages of G-E high-speed turbine governing to your process operations. R. E. Donnelly, Manager—Marketing, discusses a possible petroleum application with H. J. Chase, Manager—Engineering, at left, and C. B. Seelig Manager—Sales, center.

HIGH-SPEED TURBINES FOR ALL PROCESS APPLICATIONS

- PETROLEUM
- CHEMICAL
- PETROCHEMICAL
- STEEL

TURBINES FOR HIGH-SPEED COMPRESSORS...



THE GENERAL ELECTRIC POSITION-RESTORED GOVERNOR, shown cutaway above, utilizes the best features of both mechanical and hydraulic control. Heart of the system is a fly-ball-positioned, rotating pilot valve, which releases a tremendous store of power to position the steam inlet valves. The released power is controlled through feedback by a weight-biased mechanical-linkage that repositions the pilot-valve bushing only in direct response to movement of the steam-inlet valves, rather than in response to a force generated by the movement of the valves.

can give you close process control

In process industries, if quality-control and peak production are to be maintained, turbines that drive high-speed compressors and blowers must have close, accurate governing in response to load requirement and the slightest variations in steam conditions.

To help you get more precise control, all G-E high-speed turbines have a position-restored governor. It is an oil-relayed, mechanical-type control device that automatically matches turbine speed to process demands.

This governor will operate accurately and effectively with any recycle controlling system because the mechanical-linkage can be adjusted to match the complete output-signal range of any process controller. The G-E governor can be incorporated with a typical control system as shown in the schematic drawing.

FOR CLOSE PROCESS CONTROL the unique design of the G-E high-speed turbine governor offers these advantages:

Accurate signal relay results since speed changes are made through a weight-biased mechanical-linkage which repositions the pilot valve bushing only in direct response to movement of the steam-inlet valve. The system is not affected by oil-flow forces and is quick to respond to changes in process requirements.

Direct, precise speed settings are therefore possible because turbine response to process requirements is not dependent on force balance between springs and signal pressure.

Completely integrated governing responds not only to process demand but also to steam pressure or temperature changes, which must be factored in for close process control.

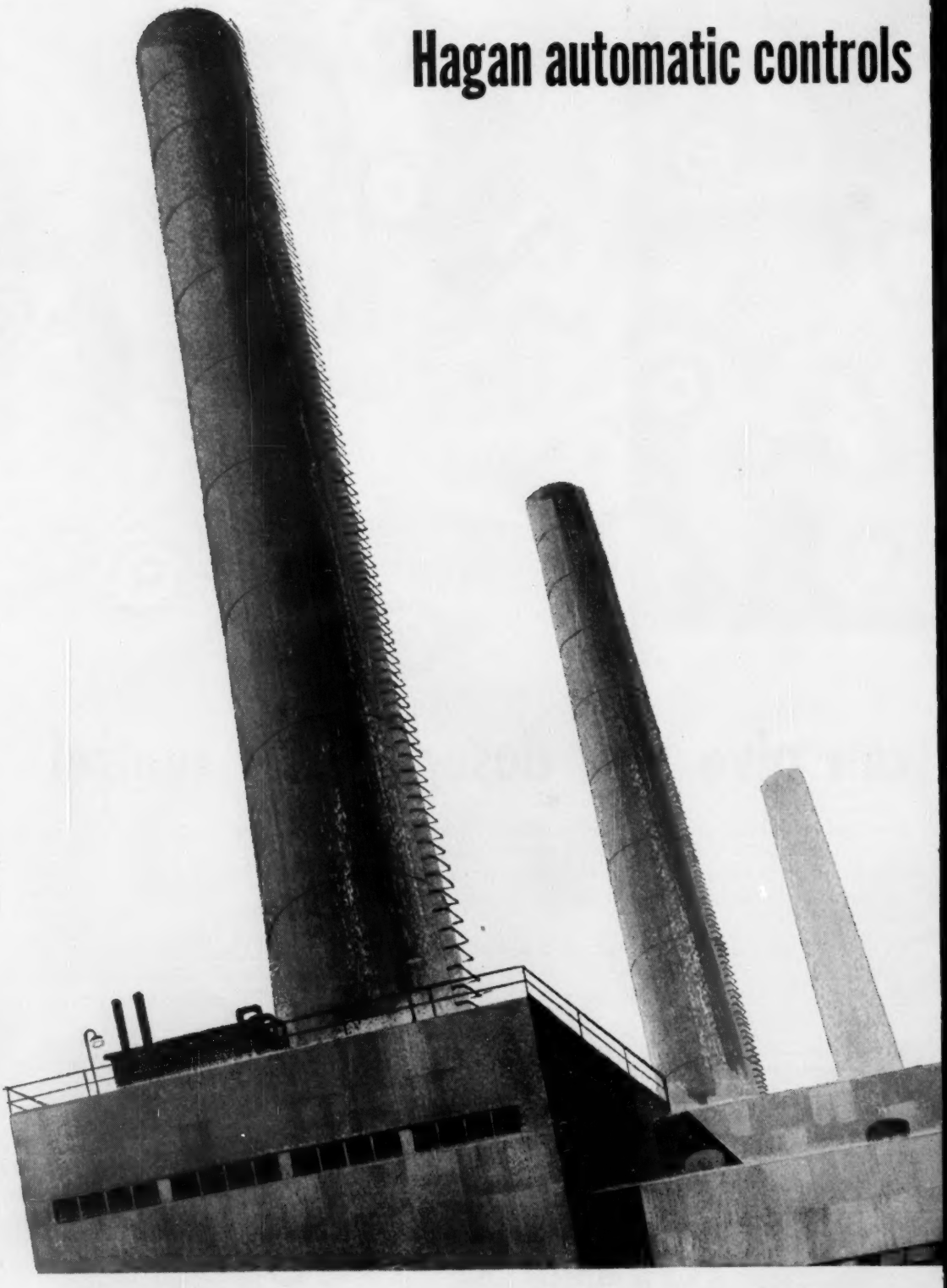
Position-restored governing keeps the system in near-perfect equilibrium, practically eliminating speed surges and turbine "hunting." Be sure to see how this governing system may be used to advantage in your process operation.

For more detailed information, contact your nearest General Electric Apparatus Sales Office or write General Electric Company, Schenectady 5, N. Y. In Canada, contact Canadian General Electric Company, Limited, Toronto. 241-3

Progress Is Our Most Important Product

GENERAL ELECTRIC

Hagan automatic controls



chosen for 5 of the largest boilers in the world!

Complete Hagan Automatic Control Systems have been chosen for 5 of the Largest Boilers in the World. Three different boiler manufacturers are represented in the Big Five, and the burners, pumps, fans, etc., are supplied by a variety of manufacturers. But take a look at the control systems for the Big Five:

	Boiler No. 1	Boiler No. 2	Boiler No. 3	Boiler No. 4	Boiler No. 5
Combustion Control	HAGAN	HAGAN	HAGAN	HAGAN	HAGAN
Three Element Feed Water Control	HAGAN	HAGAN	HAGAN	HAGAN	HAGAN
Reheat Control	HAGAN	HAGAN	HAGAN	HAGAN	HAGAN
Feedwater Pump By-Pass Control	HAGAN	HAGAN	HAGAN	HAGAN	HAGAN
Steam Temperature Control	HAGAN	HAGAN	HAGAN	X	X

It is natural that the Big Five chose complete Hagan instrumentation and control systems. For over 35 years, Hagan controls have paced each advance in boiler construction and size. The engineering know-how developed by the design and construction of automatic control systems for boilers of all types and sizes constitute one of the major reasons for Hagan's selection.

The Hagan instrumentation and control devices used in these systems are accurate, reliable and versatile. They are available to the power plant engineer as standard components for extension and modernization of existing facilities.

Hagan systems are in successful operation throughout the world. Call on your Hagan Engineer when you have an Automatic Combustion Control problem.

HAGAN CORPORATION

HAGAN BUILDING • PITTSBURGH 30, PA.

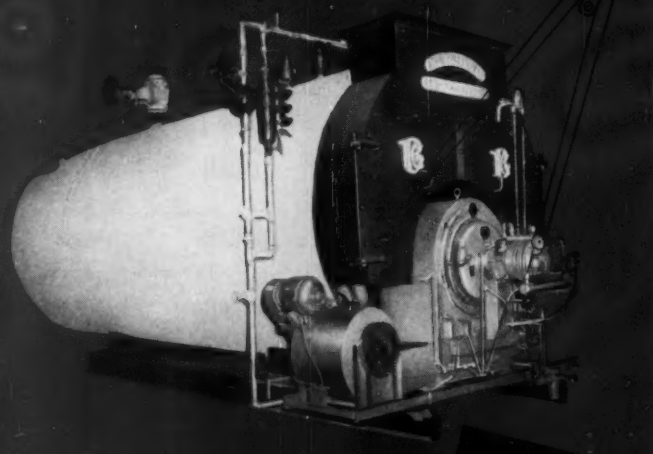
Systems and components for: Boiler Combustion Control, Process Control, Metallurgical Furnace Control, Aeronautical Testing Facilities • Industrial Water Treatment • Chemical Water Conditioning

Subsidiaries: HALL LABORATORIES, INC. • CALGON, INC.

Self-Contained Steam Production to Fit Your Need

19 SIZES
30 to 434 HP, S.B.I. Rating Delivering 45 to 651 HP, Maximum Continuous Output

BIGELOW
BOILER-BURNER
UNITS

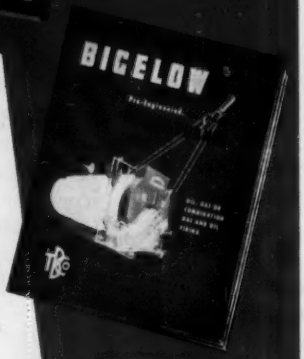


READY TO OPERATE AS SOON AS CONNECTED
Combines the boiler that closely fits your requirements with whatever top quality burner best suits your specific situation ... Mounted on a steel base ... Requires no special foundation, no high stack, no induced draft fan.

80% EFFICIENCY
Tubes correctly proportioned for efficient heat transfer promote 80% or greater efficiency.

RESERVE CAPACITY
8.2 square feet of heating surface per boiler horsepower, (STEEL BOILER INSTITUTE STANDARD) provides maximum continuous output reserve capacity 50% greater than nominal S.B.I. rating.

COMPLETELY AUTOMATIC — OIL, GAS OR COMBINATION GAS & OIL FIRING



Write For Your Copy Of This NEW BOILER-BURNER UNIT CATALOG

Catalogs also available of Bigelow Water Tube Boilers of various types.

THE BIGELOW COMPANY • NEW HAVEN 3, CONN.

Representatives: Boston • New York • Chicago • Orangeburg, S. C. • Philadelphia • Syracuse • Detroit • Washington, D. C. San Francisco • Los Angeles • Atlanta • Milwaukee • New Orleans Petersburg, Va. • Seattle • Indianapolis • Kansas City, Mo. • Tulsa Salisbury, Md. • Greensboro, N. C.

BI-17

More BOOKSHELF

Begins on page 205

of this edition have been adjusted to conform to this concept, as well as to new stress values, elastic constants and coefficients of expansion published in the Code.

Numerical examples take into account the mandatory requirement of applying stress intensification factors found to exist in components other than plain straight pipes.

Heating, Ventilating, Air Conditioning Guide 1955. *1160 pp, illust, 6x9, cloth, $12.00. Published by The American Society of Heating and Air-Conditioning Engineers, 62 Worth St, New York 13, N. Y.*

This 33rd edition is larger and improved in content. The many revisions and expansions are the result of research by the Society, changes in codes and standards, new methods in product design, and improved engineering practices.

The 53 chapters in this volume are grouped under headings of fundamentals, human reactions, heating and cooling loads, combustion and consumption of fuels, systems and equipment, special systems and instruments and codes.

Changes include several rewritten chapters, information on high-temperature hot-water heating and major revisions in many chapters. As always, this is an extremely useful book for all engineers in the heating and air conditioning phases of the power field.

Gear Design and Production. *By Reginald Trautschold. 204 pp, 6x9, 133 illust, cloth, $4.50. Columbia Graphs, Columbia, Conn.*

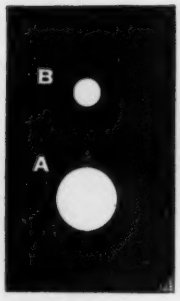
Here is a dependable guide to the latest information on gear design and production. Its main purpose is to restate the principles of gearing concisely, prove the rules and provide convenient formulas for the many critical computations in gear design.

Subjects covered include tooth profiles, speeds and power, tooth and gear production, spur, bevel, helical, herringbone, spiral, worm, spiral-bevel, shew-bevel, hpoid and internal gears, gear trains, materials and heat treatment and tooth inspection and calibration.

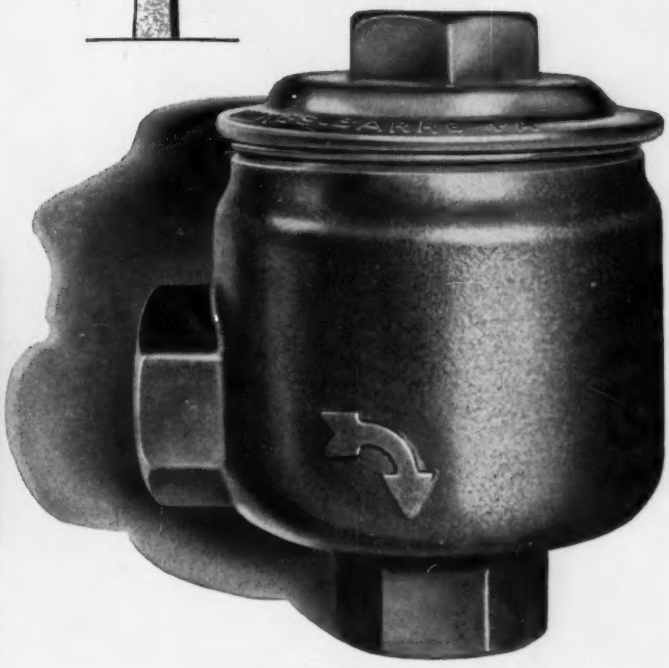
"Boy! That's great stuff."

TALK ABOUT

Capacity



Discharge orifice of 1" NICHOLSON trap (A) compared with other types of same size (B). Nicholson's greater—in every size!



Compare capacity of a Nicholson Steam Trap with any other trap of same size. Greater capacity—right across the board—means Nicholson Industrial Traps discharge condensate and air from steam lines and process equipment *faster*, more *effectively*. In toughest steam distribution service, Nicholson's pay off 4 ways:

- **lower initial cost—more for the money**
- **less upkeep expense—minor maintenance**
- **faster warmup—high, even temperatures**
- **faster production—increased 20% to 30%**

Where performance counts, specify Nicholson. Write for *Catalog 953*.

NICHOLSON

W. H. NICHOLSON and Company

TRAPS • VALVES • FLOATS • METAL PARTITIONS

14 OREGON STREET, WILKES-BARRE, PA. • SALES AND ENGINEERING OFFICES IN 58 PRINCIPAL CITIES

"Take a look at this Pritchard tower framework, Paul!"

"I'm looking. What's so special?"

"Well—one thing—they've cut out a lot of excess framework."

"Is that good?"

"I'll say it is! By cutting out a lot of the excess framework, they have made the tower much stronger. You see, Paul, they make each diagonal member carry the load both in tension and compression. And these Pritchard connector castings take the stress and strain off the bolts. See! Less material—more strength."

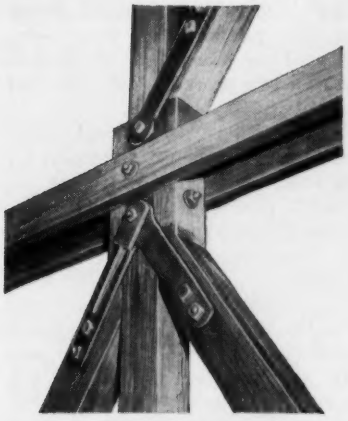
"With less material, I'll bet the tower goes up faster."

"Right. Another thing I want you to look at. Take a look down there—at the basin. That's a new Pritchard design, too. They have anchoring only around the periphery of the tower. Inside, you don't have to build post-supporting piers. Pritchard furnishes post extensions to the bottom of the basin. That saves time and money."

"Sounds so simple. Why didn't we think of Pritchard before?"

J. F. PRITCHARD & CO. OF CALIFORNIA
4625 Roanoke Parkway, Kansas City 12, Mo.

"Take a look at this Pritchard tower framework, Paul!"



PRITCHARD COOLING TOWER FRAMEWORK ONE MORE REASON TO CHOOSE PRITCHARD!

New Pritchard Cooling Tower framework is a big step forward in cooling tower design. It's stronger, yet simpler. This new efficient design makes Pritchard towers better, all the way down the line.
Yet this is just one feature that contributes to better performance—better operating efficiency.
Investigate Pritchard towers soon. Just send for the brochure offered below.

Pritchard industrial cooling towers meet or exceed new CTI standards!

FASCINATING READING!

"Answers to the 15 Questions About Pritchard Induced Draft Cooling Towers." It offers tips on evaluating cooling tower bids, tells you factors to consider in choosing a cooling tower. Send for your complimentary copy today on your company letterhead.

INDUSTRY'S PARTNER FOR PROGRESS

J.F. Pritchard & Co.
OF CALIFORNIA
A DIVISION OF J. F. PRITCHARD & CO.
Dept. 516 4625 Roanoke Parkway
Kansas City 12, Missouri

COOLING TOWERS • GAS & AIR TREATING EQUIPMENT
REPRESENTATIVES IN PRINCIPAL CITIES FROM COAST TO COAST

CLOSED FEED CYCLES

Continued from page 202

device leakoff is always returned to the pump suction.

From the foregoing it appears possible, through judicious study, to reduce the number of standby feed pumps in multiple-unit stations without unduly sacrificing operating reliability. But it is of paramount importance that this study include considerations of every factor and that any automatic controls used be the fail-safe type.

The authors have a growing interest in the possibility that whenever more than one pump is used per turbine, all standby feed pumps may be eliminated. Unexpected outage of one pump would merely require a partial reduction in load corresponding to the feedwater flow still available. Use of more than one pump per unit still protects the system during single-pump operation, just as if a standby pump were available.

EDITOR'S NOTE: *This is the final article in this series.*

NUCLEAR REACTORS

Continued from page 103

impurities from available commercial grades of inert gases. Fig. 2 shows such a system.

Inert gases may be used as the pressure medium to transfer liquid-metal coolants as needed. Inert gases may also serve shaft seal devices to eliminate or minimize external leakage of radioactive fluids.

Choosing an inert-gas system for nuclear-plant service involves many factors: (1) availability of gas (2) cost (3) radioactive isotopes formed from exposure (4) feasibility as a cover gas; for instance, argon's better than helium because of greater density (5) potential chemical reaction with coolant and effects on corrosion, mass transport and properties of coolant circuit materials (6) receiving and storage facilities needed (7) cleanup, storage and disposal of radioactive gas (8) gas heat-transfer properties (9) compressor or blower for gas handling.

Watercooled systems also need a variety of auxiliaries. The initial charge of water must be supplied by distillation or demineralization to obtain minimum dissolved solids and oxygen, and proper pH level. The same equipment will be needed to supply makeup. The same requirements have to be met for heavy water where used.

Gamma rays dissociate water into hydrogen and oxygen. The gases must

"1 for the gauge

2 for the shelf"

Saves you time . . .
avoids boiler breakdown

Reduce maintenance time on boiler water-level gauges. For every gauge in your plant, order *two* spare gauge glasses.

Why? Here's why:

Spare No. 1 is handy for you when you need a gauge glass for regular replacement during routine maintenance.

Spare No. 2 is your emergency protection against lost time, if you should suddenly need a replacement because of accidental breakage.

CORNING INDUSTRIAL GLASSWARE FOR EVERY JOB

Application	Recommended Product
Normal conditions (Up to 100 p.s.i.)	CORNING brand standard gauge glasses
Higher temperatures	PYREX brand high-pressure gauge glasses
Higher pressures	PYREX brand heavy-wall gauge glasses
Extra visibility	PYREX brand red-line gauge glasses
Viewing inside furnace, reactors, pressure vessels, etc.	PYREX brand sight glasses
Lubrication inspection	PYREX brand lubricator glasses
Visible discharge	PYREX brand oil-cup glasses

Your Industrial Distributor has the best —gauge glasses by Corning. Call today!

CORNING GLASS WORKS
Corning, New York
Corning means research in Glass

if

you have any of these troubles:

- scale, corrosion, or foaming in your **boiler operation**
- rust and corrosion in your **steam and condensate return lines**
- scale, corrosion, or algae growth in your **cooling or condenser water system**
- corrosion or scale in your **hot or cold water tank and lines**
- rust and corrosion in your **brine or sweet water system**
- scaled up **pumps, water jackets, compressors, coils, lines, or equipment**
- sludge and moisture in your **fuel oil supply**
- soot deposits in your **furnace combustion areas**

then...

let WESTERN prove to you how a specific treatment applied to your specific problem can restore and maintain efficiency and economy in your use of water, steam, and fuel. Mail the coupon today for full information.

65 Years Experience in the Chemical Treatment of Water.

Chemical Treatment for Water Steam and Fuel

WESTERN CHEMICAL COMPANY

713 Washington Street
Kansas City 5, Missouri

MAIL THIS COUPON TODAY

My problem is _____

_____

_____

_____

Name _____

Firm _____

Address _____

City _____ Zone _____ State _____

NUCLEAR REACTORS

Continued from page 213

be recombined, perhaps by an electric hot wire in presence of a catalyst.

Boiling-water reactors using heavy water must have special shaft seals and leakage recovery arrangements for the turbine, condenser gas-removal system and other points. Heavy water being produced by electrolysis or nuclear transmutation proves a costly item and must be rigidly conserved.

Watercooled reactors need other auxiliary systems already discussed for liquid-metal systems: (1) inert gas systems (2) receiving, storage and transferring (3) storage of radioactive coolant, clean-up, and waste-disposal systems.

Heavy water generally calls for special handling equipment because of its cost. Light water is a better neutron "scatterer" than heavy water, but the latter absorbs fewer neutrons.

Gas-cooled systems would use inert gases as the working fluid. When the heated, pressurized gas drives a gas turbine, special shaft seal and recovery systems may be needed. This depends on the gas used, the effect of radioactive isotopes formed and possible fission product contamination.

The next installment will cover plant controls, instruments, plant buildings and evaluation procedures—in a forthcoming issue.

More FREE LITERATURE

Begins on page 169

9 **Electric motors.** Both totally-enclosed fan-cooled and open drip-proof types of integral hp motors are detailed, with other enclosures and mounting variations, in 16-p bulletin N-100-R. Howell Electric Motors Co, Howell, Mich.

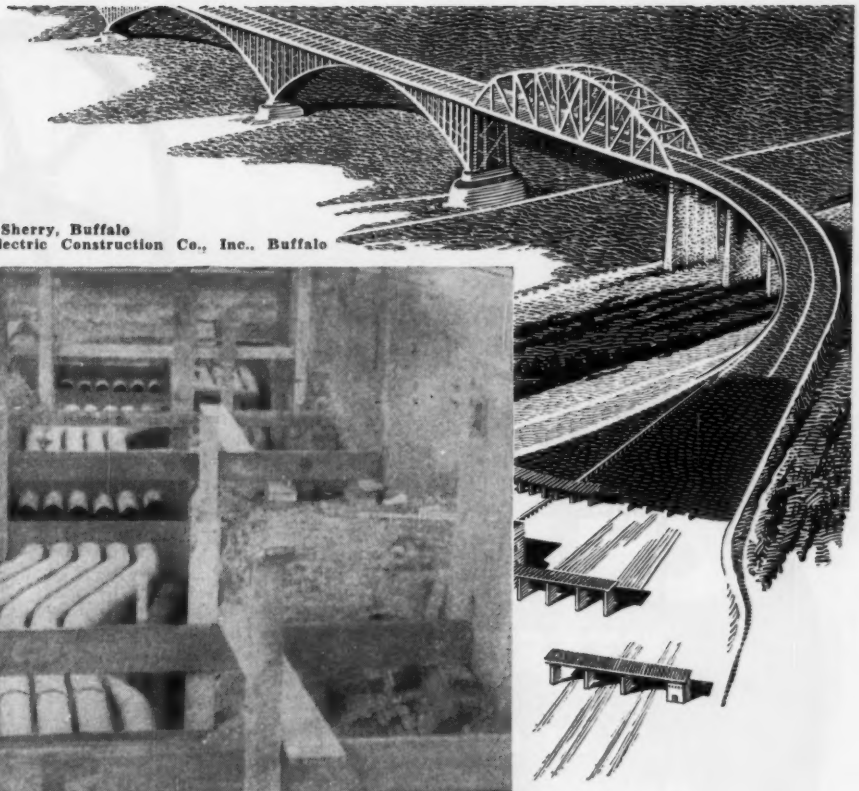
10 **Service drop cables,** available with either copper or aluminum conductors, are described in 8-p bulletin DM-5556. Conductors are insulated with either rubber and neoprene jacket or with neoprene or polyethylene. Anaconda Wire & Cable Co, 25 Broadway, New York, N. Y.

11 **Control transformers.** Illustrated 32-p catalog describes autotransformers, machine tool transformers and special application models. Contains ratings, dimensions, product features. General Electric Co, Schenectady 5, N. Y.

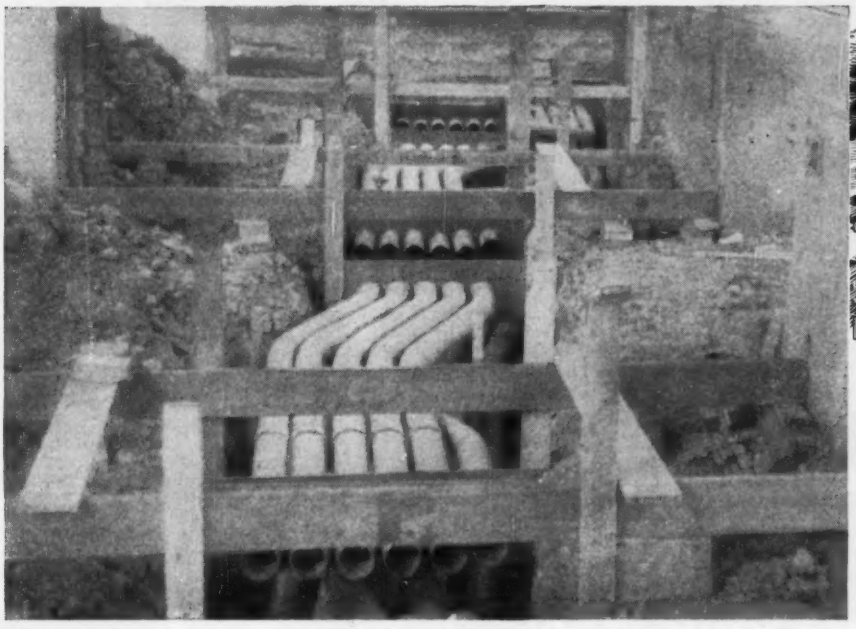
SAFETY EQUIPMENT

12 **Stair treads.** Illustrated 4-p folder describes how to repair stair treads that have become worn—shows line of extruded and cast metal treads used for stairway repair. Wooster Products, Inc, 100 Spruce St, Wooster, Ohio.

(*Continued on page 218*)



ARCHITECT—Earl Martin, Buffalo
CONSULTING ENGINEER—Walter H. Sherry, Buffalo
ELECTRICAL CONTRACTOR—Frey Electric Construction Co., Inc., Buffalo



Peace Bridge wiring securely guarded by Youngstown Buckeye Conduit

QUALITY YOUNGSTOWN SERVICE

WHY BUCKEYE IS BETTER

Youngstown is the one manufacturer who makes rigid steel conduit from ore to finished product. This enables Youngstown to control the complete manufacturing process—insurance that each length of "Buckeye" is made of top-grade steel.

Underground wiring at the Peace Bridge in Buffalo will always be safe. Permanent protection was insured by installing Youngstown Buckeye rigid steel conduit for the wiring systems of the new and vastly improved approaches on the American side.

Vital traffic controls and lighting systems can operate dependably in handling the ever-growing traffic over this greatest trade link between the United States and Canada—now nearly 4 million motor vehicles a year.

Wherever electrical wiring must function safely and efficiently in hazardous locations, install rigid steel conduit—and always use Youngstown Buckeye. It is sold by leading distributors in every industrial market.

Youngstown BUCKEYE CONDUIT

THE YOUNGSTOWN SHEET AND TUBE COMPANY *Manufacturers of Carbon, Alloy and Yoloy Steel*

General Offices Youngstown, Ohio District Sales Offices in Principal Cities.

SHEETS - STRIP - PLATES - STANDARD PIPE - LINE PIPE - OIL COUNTRY TUBULAR GOODS - CONDUIT AND EMT - MECHANICAL TUBING - COLD FINISHED BARS - HOT ROLLED BARS - WIRE - HOT ROLLED RODS - COKE TIN PLATE - ELECTROLYTIC TIN PLATE - BLACK PLATE - RAILROAD TRACK SPIKES - MINE ROOF BOLTS

Specify CHAPMAN STEEL VALVES

in any of the Standard Alloys

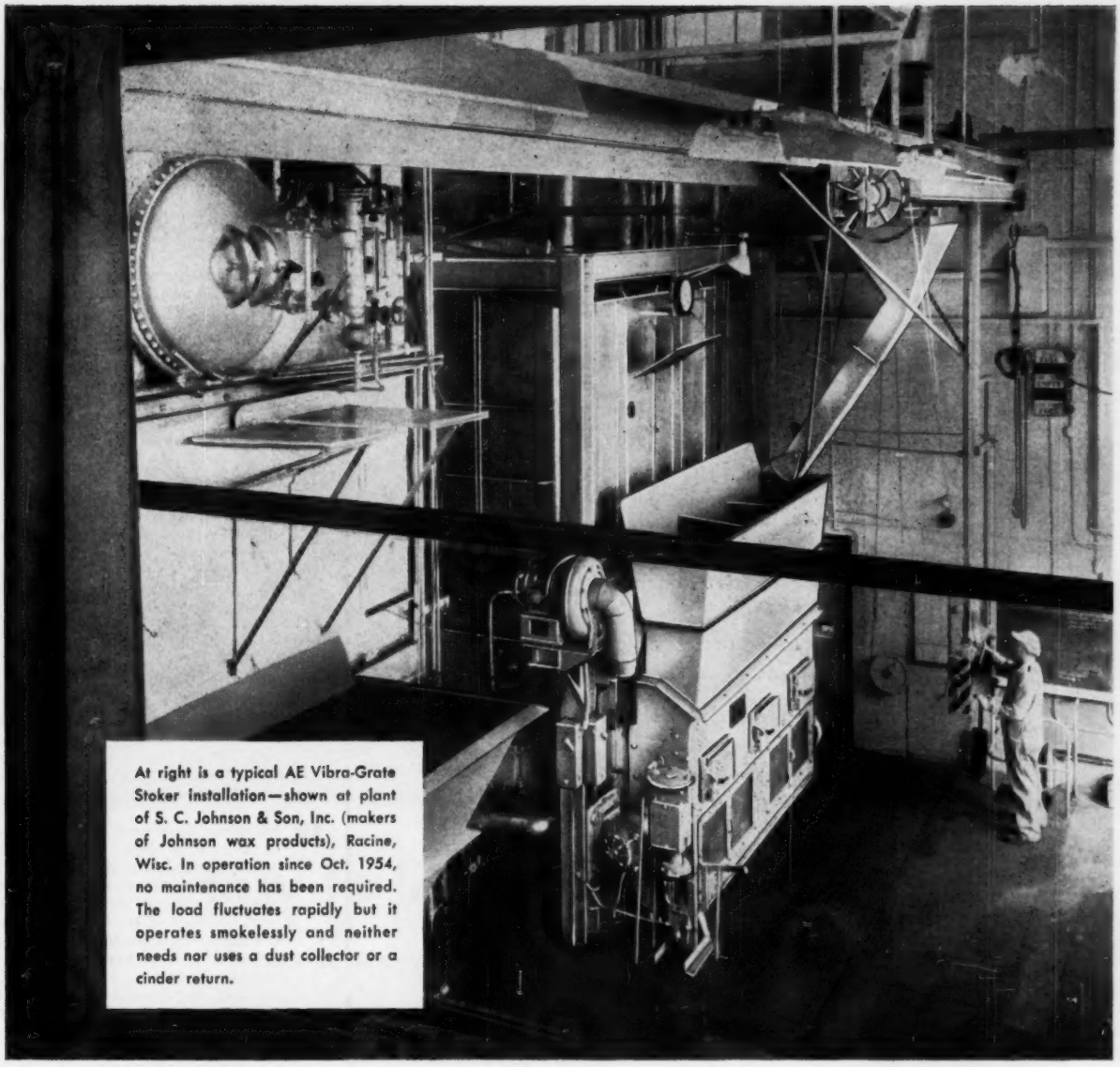
to meet your steel valve needs

When you specify Chapman Steel Valves you also specify steels designed for your specific services. Standard alloy steels match every normal industrial requirement. Special alloys can be furnished for extraordinary service conditions. All metals are poured in Chapman's own foundries under rigid laboratory supervision.

Exceptionally close machining tolerances are another standard feature of Chapman Steel Valves. Under the most severe conditions, Chapman Steel Valves seat tightly and positively, without jamming, chattering, or wearing excessively. Operation remains smooth and dependable; maintenance costs stay low.

See Chapman *first* for gates, globes and checks in all pressure classes — 150, 300, 400, 600, 900, 1500 and 2500 pounds — and for temperatures to 1150°F. Valves are available with welded, pressure seal, or bolted bonnet joints and with flanged or welding ends. ASA standards are equalled or exceeded in every range. Write for Catalog 20.

THE CHAPMAN VALVE MANUFACTURING COMPANY
INDIAN ORCHARD, MASSACHUSETTS



At right is a typical AE Vibra-Grate Stoker installation—shown at plant of S. C. Johnson & Son, Inc. (makers of Johnson wax products), Racine, Wisc. In operation since Oct. 1954, no maintenance has been required. The load fluctuates rapidly but it operates smokelessly and neither needs nor uses a dust collector or a cinder return.

Write us for latest performance report on this remarkable stoker...the

VIBRA-GRATE

Made by the makers of the Taylor and Perfect Spread Stokers

AMERICAN ENGINEERING COMPANY

WHEATSHEAF LANE & SEPVIVA STREET, PHILADELPHIA 37, PA.

Canadian Subsidiaries: Affiliated Engineering Corporations, Ltd., Montreal, P. Q. . . . Bawden Industries Ltd., Toronto, Ont.

AE products are: Taylor, Perfect Spread and Vibra-Grate Stokers, Hele-Shaw and Hydramite Fluid Power, Lo-Hed Hoists, Lo-Hed Car Pullers, Marine Deck Auxiliaries.

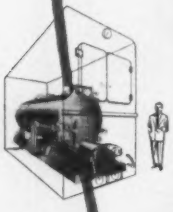
CYCLOTHERM CYCLONIC COMBUSTION

The most efficient method of combustion in steam generation!

Cyclotherm Steam and Hot Water Generators
18 to 500 hp
15 to 200 psi

Unequalled Heat Transfer Efficiency!

Cyclotherm Cyclonic Combustion guarantees a minimum 80% efficiency in oil and/or gas. Utilizes the largest possible heating area in the firetube. A flaming vortex spirals the length of the firetube. A thin layer of air prevents flame impingement . . . localized "hot spots" . . . and heat-retarding scale.

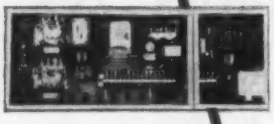


The Most Advanced Design!

Cyclotherm Cyclonic Combustion achieves its high heat transfer rate in only 2 passes. Permits a simplified design that reduces maintenance costs as much as 50%. Cyclotherm is as much as ⅓ smaller than other packaged units.

Completely Assembled On Arrival!

Factory-tested Cyclotherm costs less to ship because it's lighter in weight. Factory-insulation with fiberglas saves you up to $500 or $600. Installation requires only 5 connections. All parts necessary for safe, efficient, economical operation are supplied.



Automatic In Operation!

Electronic controls halt the Cyclotherm burner whenever operation is interrupted. A factory-pre-set water-level control automatically insures a sufficient supply of water always in the boiler. A low water cut-off control stops operation if the water supply is interrupted.

This free, information-packed booklet tells how Cyclotherm will help you achieve savings in time, costs and space. MAIL THIS COUPON TODAY!

YEARS AHEAD IN STEAM GENERATION
CYCLOTHERM®
Steam & Hot Water Generators

Cyclotherm Division, National-U.S. Radiator Corp.,
2526 E. First Street, Oswego, New York

Please send me your free booklet which shows me how I can save time, money and space with Cyclotherm.

NAME_____

COMPANY_____

ADDRESS_____

CITY_____ ZONE_____ STATE_____

More FREE LITERATURE

Begins on page 169

13 **Asbestos clothing.** Illustrated 12-p bulletin details articles of safety apparel including asbestos suits, helmets, aprons, leggings, overshoes, gloves and mittens. Johns-Manville, 22 E 40th St, New York 16, N. Y.

14 **Fire protection** is theme of illustrated 12-p bulletin that describes various types of extinguishers, fire detection and protetcion systems. Walter Kidde & Co, Inc, Belleville 9, N. J.

15 **Emergency lighting.** Completely automatic lighting units are discussed in illustrated 8-p bulletin 10. Electric Cord Co, 195 William St, New York 38, N. Y.

MAINTENANCE MATERIALS

16 **Piston packings.** Illustrated 16-p bulletin 5503 describes *Darcova Pumpcups* for packing pistons of air cylinders, hydraulic cylinders and reciprocating pumps. Includes operating diagrams, typical applications. Darling Valve & Manufacturing Co, Williamsport, Pa.

17 **Vibration mountings.** Heavy-duty general-purpose steel spring units are detailed in 4-p bulletin SS-55. Includes load capacities, dimension tables, typical installations. T R Finn & Co, 200 Central Ave, Hawthorne, N. J.

18 **Stainless fasteners.** First section of this 52-p data book contains specs, availability of a variety of corrosion-resistant metals of forty basic fastening devices. Second part consists of engr data relating to composition, properties, applications and weights of stainless steels, as well as other tables of interest to those concerned with fasteners. Allmetal Screw Products Co, Inc, Garden City, N. Y.

MATERIALS HANDLING

19 **Vertical transportation.** Guide to the selection of passenger, freight, electric-hydraulic and sidewalk elevators, dumbwaiters and escalators is provided in 28-p illustrated booklet A-398-SW. Contains capacity and dimension tables, cross-sectional drawings. Otis Elevator Co, 260 11th Ave, New York, N. Y.

20 **Overhead tracks** used for materials-handling systems are subject of 12-p bulletin 2008-L. Contains data on stresses developed, principal components used, problem of track peening, applications. Cleveland Tramrail Div, The Cleveland Crane & Engineering Co, Wickliffe, Ohio.

21 **Belt-conveyor carriers.** Illustrated 16-p bulletin 355 describes standard carriers and trippers, special carrier units, accessory equipment such as guide rolls and special tripper spouts. Stephens-Adamson Mfg Co, Aurora, Ill.

(*Continued on page 222*)

How to Select an Economical Temperature Regulator

First of all, what does *economy* mean where temperature regulators are concerned? In some industries it means improvement of product or reduction of spoilage through closer control of process temperatures. In others, it means the paring down of operating expense. The price of the regulator itself is a relatively small factor.

Today's buyers are shopping for:

1. Accuracy of control — not only when the regulator is new, but throughout its service life
2. Dependability — to prevent loss of production time
3. Minimum installation and maintenance cost

Here are a few tips on what to look for when you're installing a new or replacing an old temperature regulator —

Packless construction . . . and for this reason: A diaphragm operated, packless regulator minimizes friction. There are no closely fitted parts to stick or bind because of uneven expansion or collection of foreign matter. Also, there's less maintenance, since no repacking is ever required.

A guarantee against wire drawing of the seats and discs. Insist on it. This guarantee in combination with single seat design assures you of tight shutoff; you avoid expensive steam losses as well as loss of product in a process application.

Broad control range. In a standard regulator you should expect a control range of 100 F. And make sure the unit you select has a vapor tension thermostat that can take over-temperatures of at least 100 F.

Easy maintenance. Why ask for grief? Your temperature regulator should be basically simple in design so that it can be serviced by average plant personnel. All parts should be readily accessible for testing and cleaning.

Double duty. There's no point in buying a separate pressure regulator when you can select a temperature regulator that combines both temperature and pressure control within the same unit.

Self-operating. Make sure you get a regulator that operates on its own initial pressure. By doing so, you avoid the purchasing and maintenance of an air compressor plus air piping, and you're sure of uninterrupted operation during electric power failures.

• • • •

All of these points are important to you when it comes to selecting an economical temperature regulator. Perhaps you didn't realize you *could* expect so much. And perhaps you didn't realize that Spence Temperature Regulators offer all these features and more. May we send you our Bulletin T500 containing further details? **SE 130**

SPENCE ENGINEERING COMPANY, INC.
Walden, New York

Automation Creates Jobs For Workers With Skills

There is new and reassuring information for those who fear that "automation" — the control of machines by machines — will mean fewer job opportunities. It comes from a special survey of 1,574 companies in metalworking industries recently completed by AMERICAN MACHINIST, a McGraw-Hill publication. More than one-fifth of the companies reported that they already have automatic loading, transfer or assembly machinery in operation. In these companies as a whole there has been a net increase in total employment since this machinery was installed.

According to the AMERICAN MACHINIST survey, of these companies with actual experience in automation

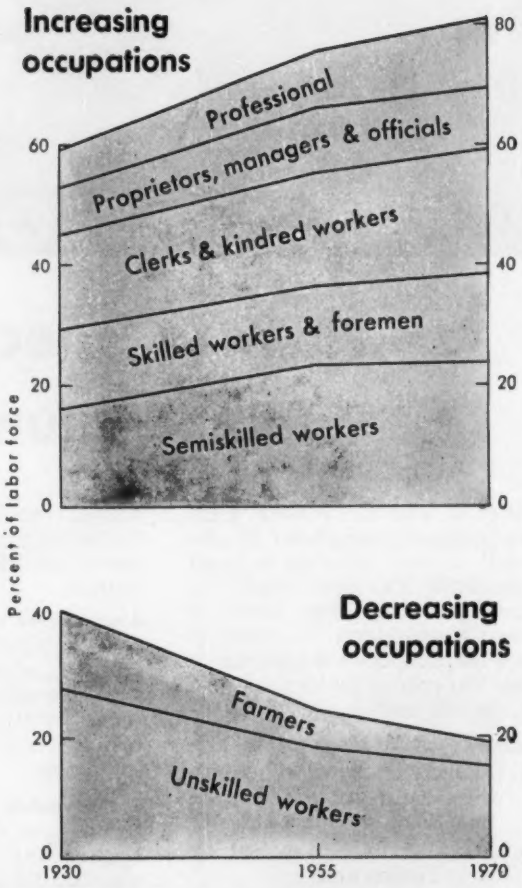
- 26% reported increases in employment averaging 21%
- 51% reported no change in total employment
- 23% reported decreases in employment averaging 16%

More Jobs for the Skilled

Of greater significance, however, is the response by 40% of these companies that they required more skilled maintenance men and by 21% of the companies that they had increased their engineering staffs. This indicates that automation is strengthening a trend already evident in the United States, a trend of expanding opportunity for those with industrial and professional skills and, relatively, of contracting opportunity for the unskilled.

The following chart shows how strong this trend has been over the past 25 years and how strong it may be expected to be over the next 15 years.

There has been a sharp decline in the percentage of unskilled workers in the nation's labor force and a corresponding increase in the percentage of those with varying degrees of skill.

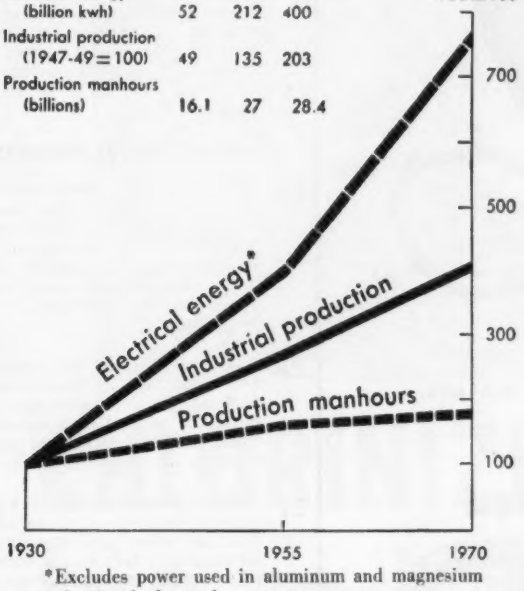


It is possible, of course, to cite cases of individuals and groups that do not conform to the charted trends. Farmers, for example, are becoming at the same time more skilled and less numerous. But this does not upset the broad proposition that opportunities are increasing for those who have skills.

Power and Production

Much of the basic explanation for the relative expansion of opportunities for those with industrial and professional skills lies in the increasing use of power-driven machinery. This has made possible a vastly greater increase in manufacturing production than in the manhours of human labor devoted to it. The following chart shows the relative increases in electrical energy and manhours of labor used in manufacturing since 1930 and the rise in industrial production.

	1930	1955	1970
Electrical energy (billion kwh)	52	212	400
Industrial production (1947-49 = 100)	49	135	203
Production manhours (billions)	16.1	27	28.4

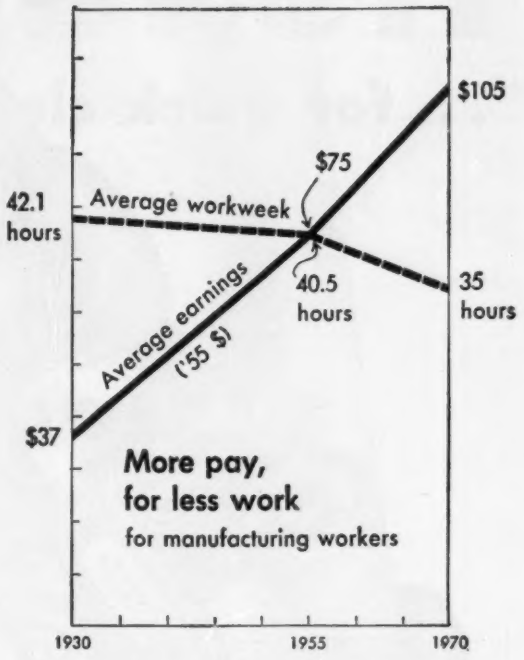


*Excludes power used in aluminum and magnesium reduction, both very heavy power users.

Power-driven machines have reduced the amount of human energy required for physical labor, but they have increased the need for skillful handling and maintenance. As the AMERICAN MACHINIST survey demonstrates, the same is true of automatically controlled machinery.

Higher Wages, More Leisure

The rising average wage of American industrial workers and the decline in hours per week that they must work reflect directly the extent to which the increase in industrial production has outstripped the manhours devoted to it. The final chart shows the increase in weekly wages (in dollars of constant purchasing power) and the decrease in the average workweek in manufacturing since 1930. It also shows the changes that may come in the next 15 years if present trends continue.



There are some who would slow what an earlier editorial in this series characterized as "the continuing process of taking dull and laborious work off the backs and minds of men and transferring it to machines operating in large batteries under automatic control." In doing so, they might make the world safer for those with no skill. The far more constructive course is to welcome the expanding opportunities now being provided and be sure that the nation's young people, who are now starting another school year, are prepared to take advantage of them.

This message is one of a series prepared by the McGraw-Hill Department of Economics to help increase public knowledge and understanding of important nationwide developments that are of particular concern to the business and professional community served by our industrial and technical publications.

Permission is freely extended to newspapers, groups or individuals to quote or reprint all or parts of the text.

Donald C. McGraw

PRESIDENT

McGRAW-HILL PUBLISHING COMPANY, INC.

It's Tops

...for quick clean cuts

7 cutters for ⅛" to 6" pipe.

...the efficiency-balanced

RIGID

Heavy-Duty Pipe Cutter

Powerfully built—guaranteed not to warp or break, always tracks perfectly . . . Famous RIGID thin-blade or heavy-duty cutter wheels of tool steel roll easily, cleanly through any pipe.* Every cutter factory-tested! Buy them at your Supply House.

*Special wheels available for stainless steel and cast iron.

For fast easy pipe cutting in tight places,
RIGID 4-wheel cutters.

RIGID
Work-Saver Pipe Tools

The Ridge Tool Company, Elyria, Ohio, U.S.A.

More FREE LITERATURE

Begins on page 169

22 **Wall chart, for wire rope slings,** lists diameters and lifting capacities of the *Strand-Laid* type slings. Measures 17x21 in., printed in 3 colors. American Chain & Cable Co, Inc, 929 Connecticut Ave, Bridgeport 2, Conn.

MECHANICAL TRANSMISSION

23 **Magnetic drive** for adjustable-speed applications is subject of 4-p bulletin 4400-PRD-229. Explains use of drive for both fan-type and constant-torque loads. Electric Machinery Mfg Co, Minneapolis 13, Minn.

24 **Chains, drive wheels** for bucket elevators and conveyors. Illustrated 8-p bulletin DC-855 contains tables on relative corrosion resistance and physical properties of various chain metals, full specs, types of chain available. Beaumont Birch Co, 1505 Race St, Philadelphia 2, Pa.

METERS AND INSTRUMENTS

25 **Transmitter** for closed-tank liquid-level measurement and control is subject of 8-p bulletin 13-22. Includes diagrams showing principle of operation and suggested installation layout, full specs and dimensions. The Foxboro Co, Foxboro, Mass.

26 **Purge meters** and flow regulators are described in illustrated 8-p bulletin 120. Contains application data, design and construction details, capacity charts. Brooks Rotameter Co, Lansdale, Pa.

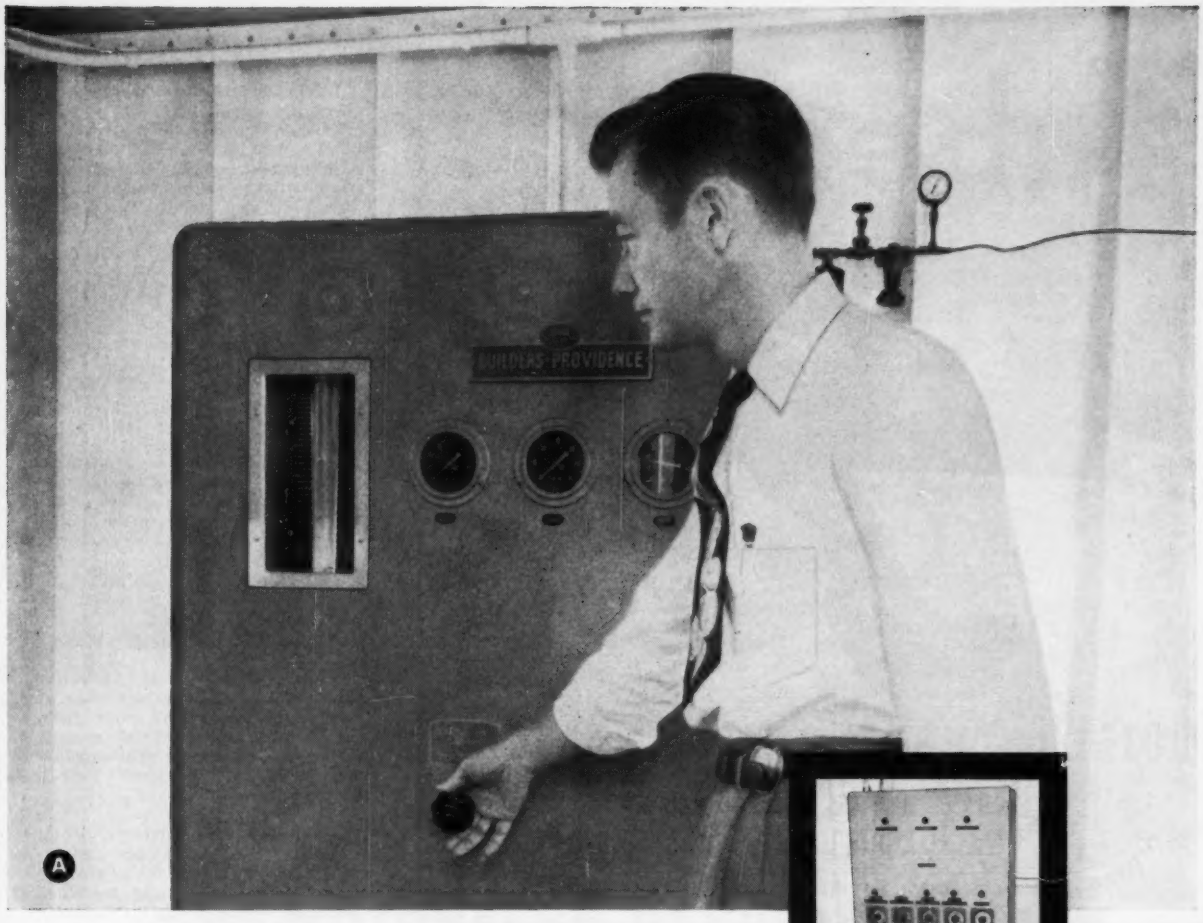
27 **Ac test sets.** Illustrated 4-p bulletin 5B contains data on sets for field or plant use. Includes descriptions of mobile, semi-portable and custom units. Associated Research, Inc, 3770 W Belmont Ave, Chicago 18, Ill.

PIPING, VALVES, FITTINGS AND SPECIALTIES

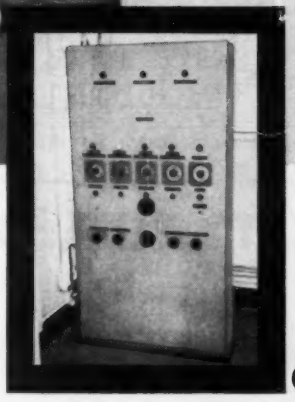
28 **Plastic pipe.** Illustrated 30-p bulletin 24 contains complete data on properties of polyvinyl chloride pipe, charts on physical properties, chemical resistance, application data, specs, fittings, installation procedures. National Tube Div, U.S. Steel Corp, 525 William Penn Pl, Pittsburgh 30, Pa.

29 **Steel tubing.** Illustrated 8-p bulletin TB-408 contains data on stainless and alloy tubing, stainless pipe, stainless sanitary tubing, heat exchanger and condenser tubing, boiler tubing and mechanical tubing. Contains table of chemical analyses, physical and mechanical properties, creep strength of 20 steels used in processing industries. Tubular Products Div, The Babcock & Wilcox Co, Beaver Falls, Pa.

30 **Solenoid-operated valves.** Three bulletins — 5S-A, covering air valves 0 to 250, 1000 and 1500 psi;



A



B

CHLORINIZER
keeps 'em clean...

. . . AT STATION B OF SAN DIEGO GAS AND ELECTRIC CO., this Builders Model HCVS 3000 lb. per day Chlorinizer reduces to a minimum hand cleaning of condensers . . . keeps condenser slime under control throughout the year. To do the job, heavy chlorine dosages are "shot" to 4 points of application: 3 pump suctions and 1 open channel. Chlorinizer, with its simple tantalum diaphragm control valve and hydraulic control system, is ideally suited to this type of automatic time-sequence control. Very slight modification of the basic Chlorinizer (Photo A) was required. The companion-type control panel (see Photo B) is an economical combination of off-the-shelf components . . . easy to adjust or service . . . low in both initial and upkeep costs.

This installation was made in 1952 at the 100,000 KW Station B, and the Chlorinizer and control panel have been in continuous service since then.

Find out how Builders Chlorinizer can solve your slime control problems . . . in main condensers . . . in heat exchangers . . . in all types of cooling systems. For Application Memo 840-J9 describing Chlorinizer slime control system — also full details on Builders Chlorinizers — write Builders-Providence, Inc., 354 Harris Ave., Providence 1, Rhode Island.

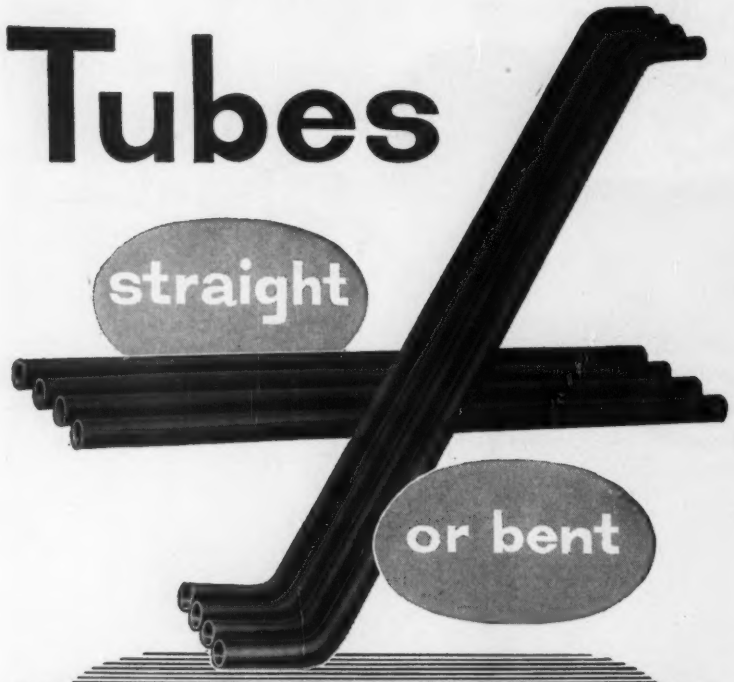
BUILDERS-PROVIDENCE

DIVISION OF B-I-F INDUSTRIES, INC.

BUILDERS IRON FOUNDRY • PROPORTIONEERS, INC. • OMEGA MACHINE CO.

BIF METERS FEEDERS CONTROLS

Tubes

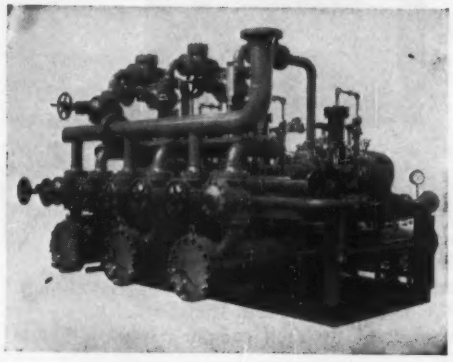


BOILER TUBE CO. OF AMERICA

McKEES ROCKS, PA.
(Pittsburgh District)

PITTSBURGH • CHICAGO • FRED S. RENAULD & CO., LOS ANGELES

LOCKETT FUEL OIL PUMPING AND HEATING SETS



The compact, high-pressure Unit shown consists of one Turbine-driven and two Motor-driven Pumps, and three Shell-and-tube-type Oil Heaters mounted on a single frame. Capacity 50,000 pounds per hour of bunker C fuel oil against 400 P.S.I. One pump and heater are spares.

Custom Built

For more than a half-century, Lockett has been supplying standard and custom-built Fuel Oil Pumping and Heating Sets, for mechanical and steam atomizing oil burners. Various types of Pumps are available: Turbine or Motor-Driven Rotary Pumps, Electric-driven Rotary Pumps, and Duplex Steam Pumps, in any combination. Units can be furnished for any capacity or pressure desired; complete with Strainers, Pressure and Temperature Controls, and Instruments. Engineered to your requirements. Completely assembled and shop-tested. Inquiries are invited. *Descriptive bulletins sent on request.*

A. M. LOCKETT & COMPANY, LTD.
Contracting Mechanical Engineers
NEW ORLEANS • HOUSTON • DALLAS

More FREE LITERATURE

Begins on page 169

5S-H, covering oil valves 0 to 250, 1500 and 3000 psi; and 5S-W, covering water valves 0 to 250, 1500 and 3000 psi—include valve characteristics, flow patterns, dimensions, photos. Barksdale Valves, 5125 Alcoa Ave, Los Angeles 58, Calif.

31 **Float-operated traps** — semi-steel for steam pressures to 250 psi and cold pressures to 300 psi—fabricated steel for steam pressures to 600 psi and cold pressures to 1000 psi—are subject of 4-p bulletin 410. The Clark Mfg Co, 1830 E 38th St, Cleveland 14, Ohio.

32 **Venturi tubes, nozzles.** Illustrated 4-p bulletin discusses applications of unit for flow-rate measurement of water, oil, gases, air and industrial wastes. Data on advantages, construction, installation, sizes, specs. Simplex Valve & Meter Co, 7 E Orange St, Lancaster, Pa.

WATER TREATMENT

33 **Aeration process,** *Ferr-X,* effective for removal of large amounts of iron, gas, taste and odor from water systems without use of chemicals, is subject of illustrated 4-p bulletin. Aquatrol Ferr-X Corp, Clifton, N. J.

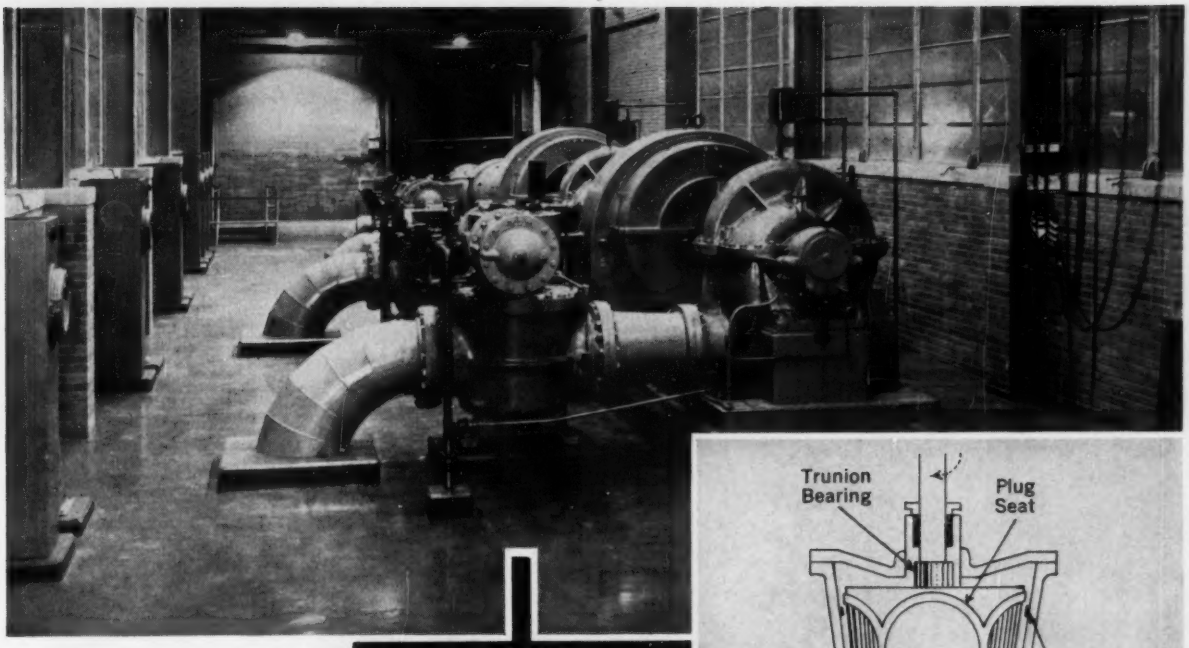
34 **Chlorinator** for purifying water supplies, treating sewage and industrial wastes and for control of slime is illustrated and described in 16-p bulletin 70-10. Contains data on design, installation, operation, safety, dimensions and specs. Fischer & Porter Co, 539 Jacksonville Rd, Hatboro, Pa.

MISCELLANEOUS

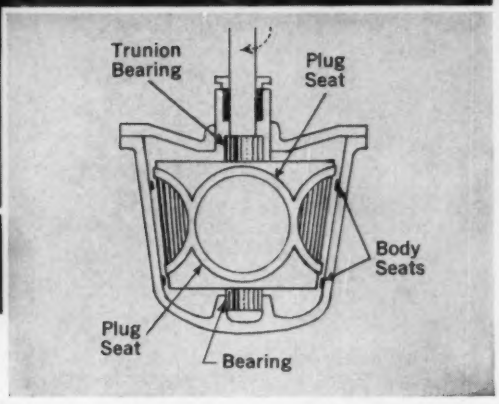
35 **"A guide** for selecting an engineering firm" is title of 18-p booklet prepared for top management. Differentiates between types of engineering firms, sketches criteria for determining whether present engineering staff is adequate to do the job, outlines guide posts for selecting an outside firm. The Teller Co, Group P, Butler, Pa.

36 **Product handbook.** Illustrated 52-p publication describes company's industrial lines—including insulation and refractory products, Transite asbestos-cement pipe, packing and gaskets, electrical products, filter aid and mineral fillers, synthetic silicates, floorings, roofing and sidings. Johns-Manville, 22 E 40th St, New York 16, N. Y.

37 **Product handbook.** Illustrated 28-p bulletin GSP-901 summarizes products and services of parent company and three subsidiaries. Automatic control and instrumentation components; water conditioning and steam-testing equipment, chemical feeding devices; chemicals for food processing, paper processing and for metal protection, are some of subjects discussed. Hagan Corp, 323 4th Ave, Pittsburgh 30, Pa.



SMS
ROTOVALVES



SMS-ROTOVALVE DESIGN ASSURES POSITIVE CLOSING, LONG LIFE

For fast, easy operation and positive closing, specify SMS-Rotovalves. As shown above, the conical plug, with full line opening, first lifts, then turns, finally reseats. Bronze trunnions eliminate friction and wear to seats, the causes of failure and breakage. Self-purging monel to monel seating assures drop-tight closure.

Rotovalves are designed to solve your control problems. You can be sure of easy operation, precise aperture control, controlled closing time, positive closure, easy mechanical cleaning, low maintenance and long service life. The Rotovalve's full line opening means less head loss and lower pumping costs.

Performance characteristics like these are the result of more than 75 years of hydraulic research and engineering. To get full information on the complete line of Rotovalves, Ball Valves and Butterfly Valves, contact our local representative or write S. Morgan Smith Co., York, Pa.

S. MORGAN SMITH

AFFILIATE: S. MORGAN SMITH, CANADA, LIMITED, TORONTO

HYDRODYNAMICS

HYDRAULIC TURBINES
PUMPS
GATES & HOISTS
TRASH RAKES
ACCESSORIES
ROTOVALVES
BALL VALVES
BUTTERFLY VALVES
FREE-DISCHARGE VALVES
CONTROLLABLE-PITCH SHIP PROPELLERS

SONDERGLASS
How to look at
500 lbs. of steam
safely
Safeguard your eyes from scalding steam and flying glass. Watch your water level safely through SONDERGLASS, the safe gauge glass. Virtually two tubes in one . . . the outer hardened to resist cold drafts and erosion . . . the inner to withstand great heat.
Sonderglass has been dipped into 450°F oil and repeatedly plunged into cold water without spalling or cracking.
Today, equip your boilers with the safe glass — Sonderglass — and enjoy the satisfaction of knowing that you have the best.
SONDERGLASS
THE SAFE GAUGE GLASS
CLEAR
REFLECTING

PACKING
Chesterton
SERVICE

NEW PRESSURIZED SPRAGRIP

First Effective Treatment for V Belts

Spragrip is an entirely new development and unlike any other belt dressing you have ever used. It is a permanent type dressing that gives an immediate power boost and will not lose its grip due to aging, oxidizing, glazing or drying out on the belt. Treat your V, flat, round, leather, rubber or fabric belts the easy way. Just press the button on the modern pressurized can of Spragrip and safely spray hard-to-reach sheaves and belts with this power boosting formula. The same formula is packaged in spout applicator cans under the trade name Belt-Flo. Money back guarantee. Write the A. W. Chesterton Co., Everett 49, Mass. for full information.

More TECHNICAL BRIEFS

Begins on page 156

particular enthalpy. A balanced combination exists for each value of stagnation enthalpy. These combinations are independent of the design of the remainder of the plant.

Analysis that follows develops not only the balanced relationship between the two areas but also rate of return on marginal investment in these plant elements for each balanced combination. This is expressed in terms of improvement in stagnation enthalpy per marginal dollar invested for each unit of condenser flow. This information is directly applicable to the selection, on economic grounds, of the particular balanced combination appropriate for a given power plant. *ASME paper No. 55-S-31.*

An industrial application of a marine-type power plant. *By T J Judge, International Paper Co.*

A marine-type power plant, removed from a T2-SE-A1 Maritime Commission tanker being reconditioned and repowered, was installed on land in 1948 to provide a temporary source of electric power for a pulp and paper manufacturing plant. Its operation was successful and many of the outstanding design features were adopted in specifications for subsequent power equipment.

The plant has now operated successfully for more than six years with a record of low maintenance and remarkably high availability.

Features of the marine plant still under consideration for future installations include fabricated-steel turbine foundation, gravity-type lube-oil system, high furnace heat-release rate, compact construction and arrangement of equipment. *ASME paper no. 54-A-220.*

Multi-fuel boiler control. *By Paul Thanos, Inland Steel Co. APC paper; no number.*

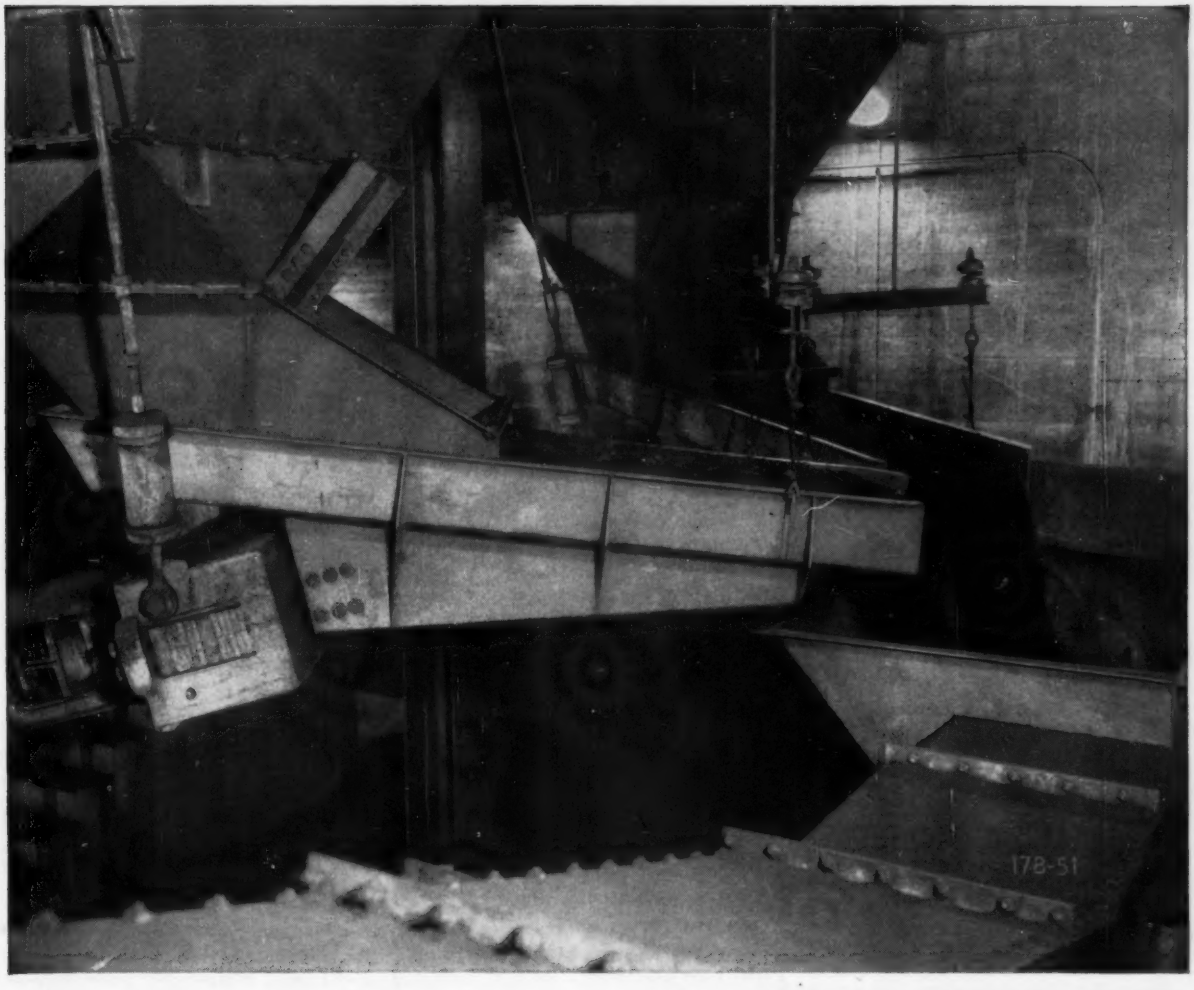
Air preheater for small power plants. *By W E Hammond and C L Brown, The Air Preheater Corp. APC paper; no number.*

Sealing regenerative-type air preheaters for high-pressure differentials. *By G D Braddon, T L Woolard and E P Horn, The Air Preheater Corp. ASME paper; No. 55-S-41.*

The monotube once-through boiler for conventional or supercritical pressures. *By Arthur T Hunter, Combustion Engineering, Inc. APC paper; no number.*

Research in the field of steam generation. *By Wilbur H Armacost, Combus-*

Directions for ordering papers on p 232



Jeffrey puts VIBRATION to useful work

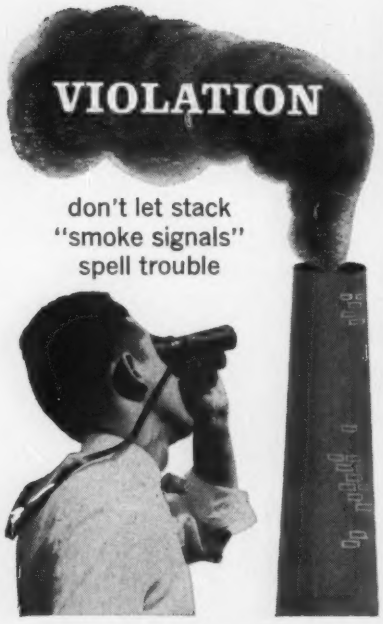
YOU CAN SOLVE many flow-control problems with Jeffrey Electric Vibrating Feeders. They provide highly efficient regulation of the flow of coal from hoppers and bins to conveyors, elevators, crushers, jigs and so on. Coal is propelled in a smooth, continuous stream by each forward vibration stroke.

Balanced vibration in the Jeffrey system matches electrical frequency to the natural mechanical frequency of the driven equipment. This makes the system economical to operate, since all available energy does useful work. It is easy to control, safe, quiet and dependable. Vibration is isolated within the conveyor by scientifically designed supports.

Jeffrey's years of experience with conveying problems enable us to furnish systems exactly right for each particular task. Catalog 870 describes the complete line of Jeffrey Vibrating Equipment. For a copy, and for help on your conveying problems, write The Jeffrey Manufacturing Company, Columbus 16, Ohio.

JEFFREY

CONVEYING • PROCESSING • MINING EQUIPMENT • TRANSMISSION MACHINERY • CONTRACT MANUFACTURING

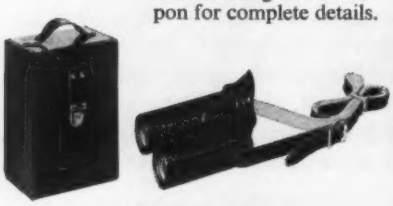


don't let stack "smoke signals" spell trouble

estimate smoke density accurately in seconds with the

NEW M•S•A SMOKESCOPE

This precision built, optically accurate instrument gives you a reliable method of estimating smoke density. The lens projects a standard reference film disc to a focal distance equivalent to that of the smoke. This permits accurate, quick comparison without changing eye focus. Background variations, ambient light are minimized. Sturdy leather carrying case protects Smokescope, aids handling. Fill in coupon for complete details.



MSA
SAFETY EQUIPMENT HEADQUARTERS

MINE SAFETY APPLIANCES CO.
201 North Braddock Avenue, Pittsburgh 8, Pa.
82 branch offices in the United States and Canada

Mine Safety Appliances Company
Please send me complete details on the new M.S.A. Smokescope

Name_____

Firm_____

Address_____

City_____ State_____

P

More TECHNICAL BRIEFS

Begins on page 156

tion Engineering, Inc. APC paper; no number.

Standard boilers—influence of design changes on cost. *By D Cassino, Foster Wheeler Corp. APC paper; no number.*

Fast starting of 150,000 pound per hour industrial boilers. *By C E Morrow and R F Born, Western Electric Co, Inc. APC paper; no number.*

Bearings

Water-lubricated bearing studies. *By A Smaardyk, Argonne National Laboratory.*

Various types of bearing designs and bearing materials are evaluated for use in component mechanisms for water-cooled, nuclear-powered plants. Experimental test facilities designed to simulate anticipated operating conditions are described in this paper. The test data in both graphical and pictorial form include corrosion resistance and wear characteristics of the most promising water-lubricated bearing designs and material combination for operation in high-purity water at temperatures ranging from 200 to 500 F. *ASME paper No. 55-SA-42.*

Heat transfer

Flame geometry as a factor in industrial heat processing. *By R C LeMay, Selas Corporation of America.*

The usefulness of fuels can be and is now being increased by employing additional controls beyond those normally exercised in typical "heat liberations." These additional controls are directed largely toward influencing flame geometry, and through this to the more effective heat transfer required by modern industry. Over-all objectives include movement of heat-treatment from remote locations to primary production lines—a basic requirement of automatic production. *ASME paper No. 55-SA-10.*

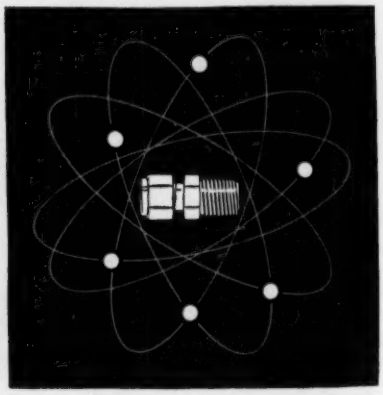
A new method of evaluating dynamic response of counter-flow and parallel-flow heat exchangers. *H M Paynter and Y Takahasi, Massachusetts Institute of Technology.*

From the exact solutions for the frequency response of counter-flow and parallel-flow heat exchangers, successive parameters are calculated which give direct information for the heat exchangers regarding transient responses as well as frequency responses.

(*Continued on page* 230)

Directions for ordering papers on p 232

NOW Swagelok®
TUBE FITTINGS FROM
ALUMINUM
TO
Brass, Carpenter 20, Gold, Hastelloy, Inconel, Monel, Nickel, Platinum, Silver, Stainless Steel, Steel, Tantalum, Teflon, Titanium, Zirconium
ZYTEL*
POLYAMIDE RESIN



From aluminum to "Zytel" there's a Swagelok answer to your fitting problems. The new Swagelok Tube Fittings of "Zytel" are for use with plastic tubing in applications where corrosion is a problem. They are the first to be made in a complete range of shapes that include elbows, tees, reducers and adapters.

The new Swagelok Tube Fittings of "Zytel" are made to the unique Swagelok patented design that provides strong, torque-free and leakproof joints at all tubing connections. Sleeves or inserts are unnecessary. Specify Swagelok for every fitting need and eliminate unnecessary fitting problems.

FREE: For complete information write for the Swagelok catalog. Address Dept. E-41

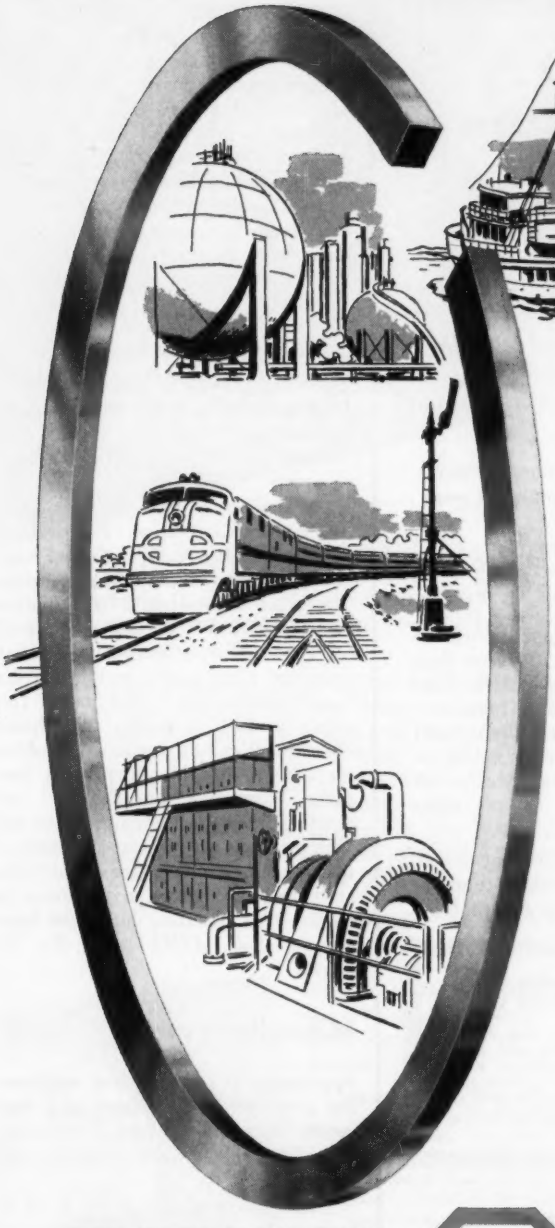
Swagelok Tube Fittings Are
Easy to Use
No Special Tools Needed
No Flaring or Threading

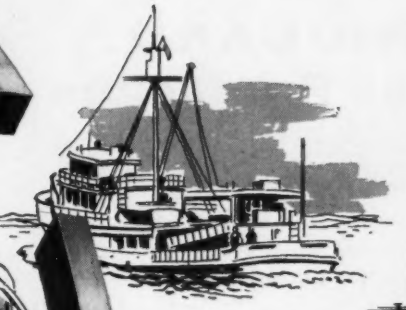
*DuPont trade-mark

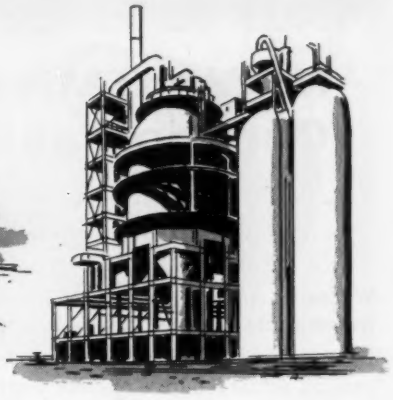
CRAWFORD FITTING CO.
884 E. 140th Street
Cleveland 10, Ohio

American Hammered Piston Rings . . .

field-tested money savers!







Why not specify piston rings that have *proved* themselves? Koppers rings have been saving money and cutting costs for years—throughout the oil and gas industry, the marine industry, on major railroads, all over the chemical field, throughout the aircraft business, in municipal and industrial power plants everywhere—wherever you find gas, Diesel or steam engines, pumps, compressors, forging hammers—*wherever piston rings are needed!*

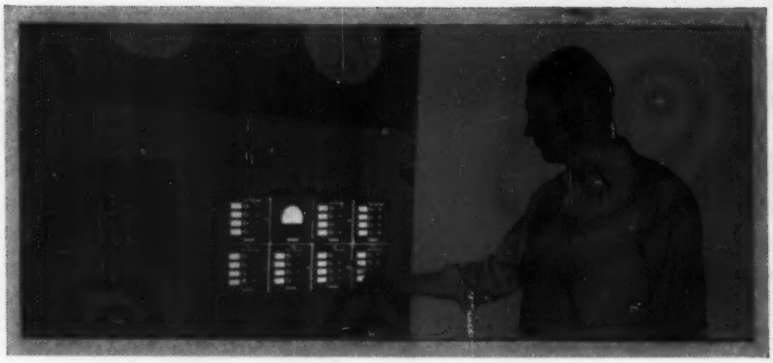
They're built to take it . . . designed to cut downtime and maintain high compression . . . give longer, more satisfactory service . . . save you money on fuel and lubricating oil . . . *and that's exactly what they do.* And Koppers rings are available in all types, all sizes—from ½" to 10′ diameter—specifically designed for the job they will do in the field where they will be used.

Always specify American Hammered Piston Rings. Benefit from over 100 years of experience in metal products. Use Koppers' complete engineering and metallurgical staff. Get skilled analysis of your specific problem, and prompt assistance. For 16 page Piston Ring booklet write to: KOPPERS COMPANY, INC., *Piston Ring & Seal Dept.,* 1551 Hamburg Street, Baltimore 3, Maryland.

METAL PRODUCTS DIVISION • KOPPERS COMPANY, INC. • BALTIMORE 3, MD. This Koppers Division also supplies industry with Fast's Couplings, Industrial Gas Cleaning Apparatus, Aeromaster Fans, Gas Apparatus.
Engineered Products Sold with *Service*

KOPPERS

AMERICAN HAMMERED
Industrial Piston Rings



NOW OMNIGUARD...
Can Increase Production
...through low-cost insurance against down time

Whenever conditions call for prolonged, full capacity operation, critical temperatures can cause bearing failure – and result in ruinous shutdowns.

Increased temperature also shortens bearing life expectancy, before causing actual failure – another costly factor in the long run.

This is where the Edison Omniguard comes in – and where it pays its way many times over.

Omniguard's central monitor panel keeps *one* operator constantly posted on bearing temperatures in every plant unit . . . allows running at peak loads with safety.

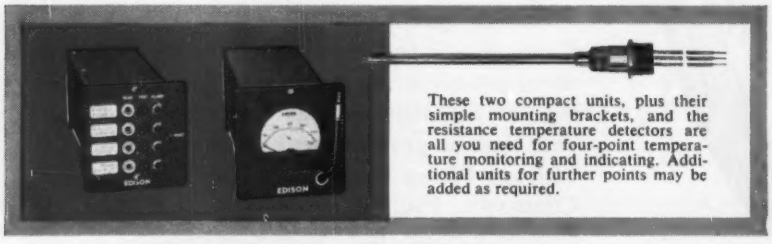
And full capacity operation can be maintained longer – because Omniguard sounds its warning before the damage level is reached.

You can trust Omniguard - because

- Entire system has no moving parts only simple *electrical* circuits, nothing to wear out.
- No adjustments or maintenance necessary – and installation costs are so low because only a minimum of wiring is required.
- Resistance Temperature Detectors are guaranteed accurate to ± 1% – drift less than ± .05%.

And Edison Omniguard costs so little . . . upwards of 50% less than any other monitoring system. This is truly the lowest cost insurance against down time–and Omniguard is so flexible – protects small or large plants with equal ease for an initial investment of less than $500.00.

Write today for article that shows how just a small increase in temperature can cut bearing life in half.



These two compact units, plus their simple mounting brackets, and the resistance temperature detectors are all you need for four-point temperature monitoring and indicating. Additional units for further points may be added as required.

Thomas A Edison

A GREAT NAME CONTINUES GREAT NEW ACHIEVEMENTS

Thomas A. Edison

INCORPORATED

INSTRUMENT DIVISION • 41 LAKESIDE AVENUE • WEST ORANGE, NEW JERSEY

More TECHNICAL BRIEFS

Begins on page 156

The numerical evaluations of the parameters from the design data of heat exchangers are generally very simple, although the formulae themselves appear somewhat involved. Good coincidence with measured transient responses is demonstrated on an example. *ASME paper No. 55-SA-50.*

Average and local heat transfer for crossflow through a tube bank. *By R A DeBortoli, R E Grimble and J E Zerbe, Westinghouse Electric Corp.*

Heat-transfer coefficients have been determined for a crossflow tube bank by the use of the heat-and-mass-transfer techniques for the Reynolds-number range of 35,000 to 80,000. The average heat-transfer coefficients agree favorably with extrapolations of existing data. The local coefficient variations from the average were as great as +80 per cent and –55 per cent. *ASME paper No. 55-SA-51.*

Fuels

Coal and ash handling Martins Creek steam electric stations. *By W H Kopenhaver, Pennsylvania Power & Light Company.*

On October 1, 1954, Martins Creek Steam Electric Station, Pennsylvania Power and Light Company's first semi-outdoor plant was placed in operation. The plant is fired with 100% pulverized bituminous coal and is designed for low-load-factor operation. The outdoor-type plant is new to the industry in the northeastern United States. This paper presents a general description of the plant and its operation and deals specifically with bituminous-coal handling, pulverizing, burning, and ash handling. Some operating problems and their solutions are discussed. Reference is made to a duplicate second unit presently under construction scheduled to be placed in operation during the Summer of 1956. *ASME paper No. 55-SA-46.*

Miscellaneous

Application of some systems engineering principles to the design of a fuel supply system. *By Adolph E Buescher, Jr, and George J Fiedler, Sverdrup and Parcel, Inc.*

The purpose of this paper is to illustrate by example the benefits of "systems engineering" as applied to process controls. The example is an actual case history. Both dynamic and

Directions for ordering papers on p 232

Now—CORROSION PROTECTION at a BUDGET PRICE

SCHAUB "03" *Deaerators*

- NEW, SIMPLER PRINCIPLE
- FIGHTS "RETURN LINE" CORROSION
- POSITIVE OXYGEN REMOVAL TO .03 CC/LITER

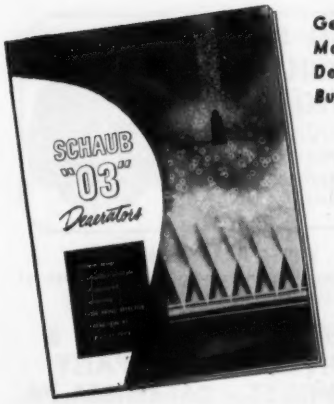
● Here is a deaerator of Schaub quality, engineered on new principles, designed especially to put effective boiler feed water deaeration within price reach of the small to medium size plant.

These plants, from 3,000 to 30,000 lbs/hr., often running at low pressure, are likely to have the same corrosion and high maintenance costs as their "big brothers". In fact, "Return Line Corrosion" is *most apt* to occur in *low pressure* heating systems even though raw water make up is negligible. For such plants, as well as for high pressure installations, the Schaub .03 Deaerator offers an effective and economical solution that will pay for itself many times over.

The Schaub .03 Deaerator operates *fully vented* at atmospheric pressure. Premium cost construction is eliminated, maintenance and operating costs are reduced to a minimum. Liberated, non-condensible gases escape *immediately* and *completely*. At the same time, simple but effective spray-contact vent condensing, prevents wasteful steam vapor loss. Pin-point temperature control, "live-action" heating and rust-proof chromasoid lining are exclusive features.

FRED H. SCHAUB ENGINEERING COMPANY

2105 South Marshall Boulevard • Chicago 23, Illinois



Get the Full Story on This More Efficient Low Cost Deaerator — Write for Bulletin 1300

Simple though it is, there's much more to the Schaub .03 Deaerator than can be told here. Bulletin 1300 is filled with information for the operating or consulting engineer responsible for economical and efficient deaeration of boiler feedwater. Tells the "hows" and "whys" of deaeration, especially for the small to medium size plant, explains how the Schaub method differs and its advantages in performance and low cost. Mail the coupon today.

NOTE: The Schaub .03 Deaerator is designed for boilers up to 30,000 lbs. per hour. For capacities up to 100,000 lbs. per hour at .005 cc/liter "zero-oxygen" removal write for Bulletin 575, describing the Schaub Zero-Oxygen Deaerator.

FRED H. SCHAUB ENGINEERING COMPANY
2105 South Marshall Blvd., Chicago 23, Illinois

Please send me, without cost or obligation, my personal copy of your new Bulletin 1300 on Boiler Feedwater Deaeration.

NAME.....

COMPANY.....

ADDRESS.....

CITY.....ZONE....STATE.....

At times it pays to be blinded !

But certainly not when you analyze coal values. Before you contract or place an order for your coal supply, a comparative study of evaporative results should be made.

No coal is 100% efficient. But with a properly, uniformly sized coal you'll utilize a higher percentage of Btu content. This more efficient combustion means lower steam costs for you.

At our Enos and Enoco Mines . . . specific gravity washing, exact sizing and mechanical size blending produce a coal free of loose impurities, tailored to your stoker requirements. Each shipment is guaranteed to be of the same uniform size-consist and high quality. You'll find that exactly sized, properly prepared Enos and Enoco coals reduce Btu waste.

Why not give us a call today? Let us *prove* that superior preparation of quality Enos and Enoco coals give you more efficient utilization of Btu content for lower steam cost.

Place a trial order.
Make a test comparison.

THE ENOS COAL MINING COMPANY

Sales Offices for Enos and Enoco Coals

1405 Merchants Bank Bldg. Indianapolis 4, Indiana
310 S. Michigan Ave. Chicago 4, Illinois

More TECHNICAL BRIEFS

Begins on page 156

steady-state performance of the process are considered.

Systems analysis prevents overemphasis of either the physical problem or the over-all performance requirements, so that the control configuration chosen is truly optimum and equipment selection is put on an economic basis. The control system designed is a fuel-supply system for an aircraft-engine test facility. The spacing limitations, performance requirements, and range of operating conditions are given. A design based on systems-engineering principles is outlined and methods for defining the functional requirements for components are derived.

For reasons of brevity, the paper does not discuss the final design in detail; however, certain specific design problems are solved with emphasis on application and numerical work. A satisfactory mathematical relationship between flow and pressure is derived. Optimum mode of control for the system is found and control valve-location requirements are determined. *ASME paper No. 55-SA-55.*

TO OBTAIN COMPLETE TEXT

Material for these abstracts comes from the following sources unless otherwise stated. Order complete paper from source, not POWER.

American Society of Mechanical Engineers. Identified by initials ASME and obtainable through ASME, 29 W 39th St, New York 18, New York.

American Power Conference, 17th annual meeting. Identified by initials APC and obtainable through purchase from R A Budenholzer, chairman, Illinois Institute of Technology.

World Symposium on Applied Solar Energy. Identified by initials WSASE and obtainable through Public Relations Dept, Stanford Research Institute, Menlo Park, Calif.

Fourth and final unit of California Electric Co's Highgrove (Calif.) steam plant has been placed in operation. The 40,000-kw unit boosts rated output of the plant to 140,000 kw.

The atomic reactor that India will receive from Canada as gift under the Colombo Plan, will be set up in Bombay where another swimming-pool type reactor is nearing completion under the supervision of the Indian Atomic Energy Commission.

Catawissa PERFECT SEAL Unions

HOT FORGED from solid, rectangular steel bars, designed and produced for dependable, long-life service under the severest piping conditions!

A TYPE FOR EVERY USE!
FOR ALL PRESSURES!
FOR ALL TEMPERATURES!

Standard & Double Extra Heavy UNIONS
Available with screwed or socket weld ends. 3000-lb. sizes ⅛" to 3"; 6000-lb. sizes ⅛" to 2".

ORIFICE UNIONS
With screwed or socket weld ends. 3000-lb. and 6000-lb. service.

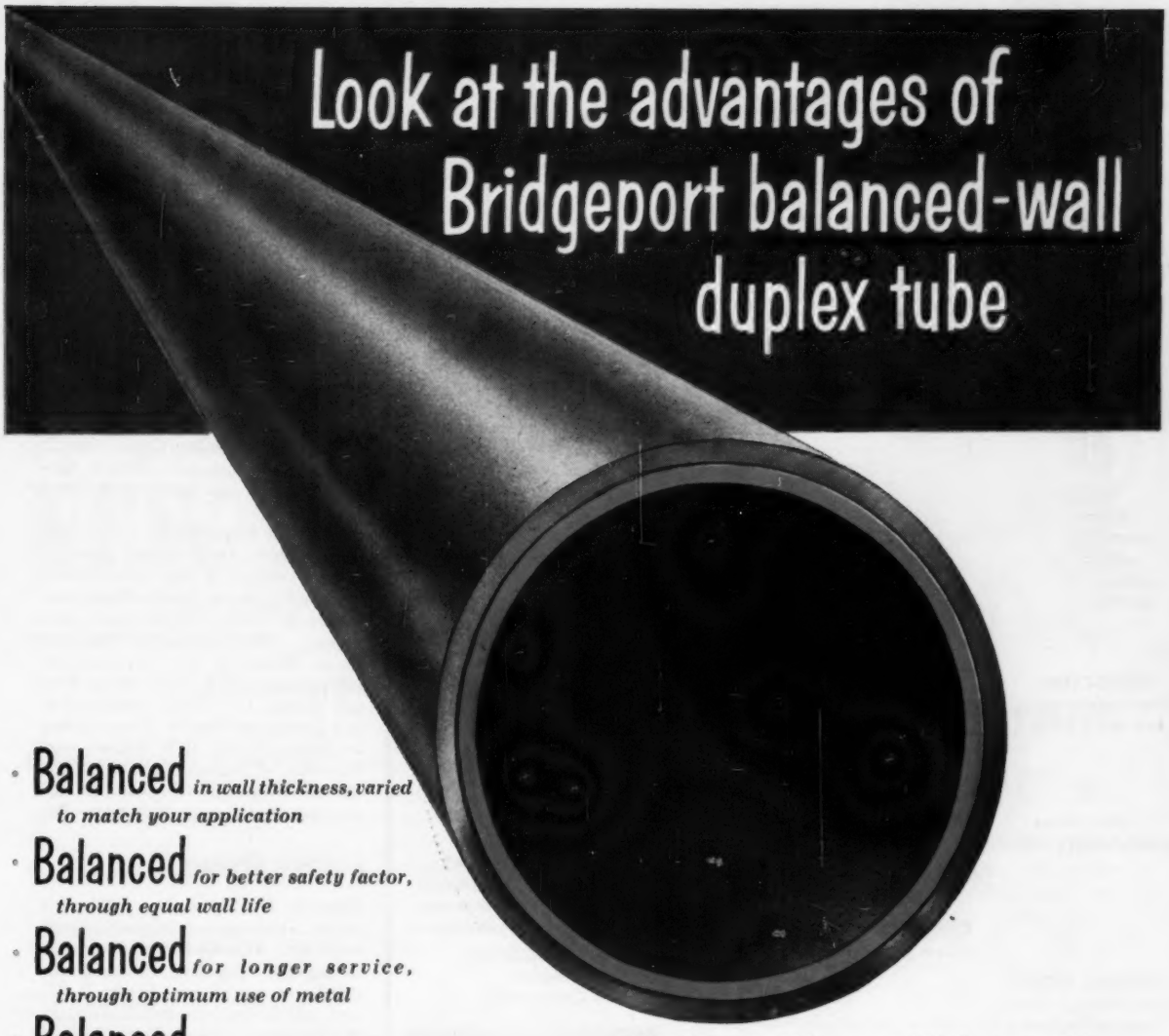
MALE & FEMALE UNIONS
With steel-to-steel, bronze-to-steel, stainless steel-to-steel or orifice seats. 3000-lb. service only.

FULL STAINLESS & FULL ALLOY STEEL UNIONS
With screwed or socket weld ends. 3000-lb. and 8000-lb. service.

WRITE FOR CATALOG 11
showing the complete Catawissa line of Perfect Seal products

CATAWISSA VALVE & FITTINGS COMPANY
206 MILL ST. • CATAWISSA, PA.

Look at the advantages of Bridgeport balanced-wall duplex tube



- **Balanced** *in wall thickness, varied to match your application*
- **Balanced** *for better safety factor, through equal wall life*
- **Balanced** *for longer service, through optimum use of metal*
- **Balanced** *in metal specification to resist different types of corrosion, inside and out*

Bridgeport Duplex Tubes are available in many combinations of copper-base alloys with steel, aluminum and other metals. Lifetime Costs Are Lowest With Bridgeport Duplex Tubing.

Before specifying any heat-exchanger tubes, consider these facts: The job of each Bridgeport Duplex Tube is analyzed and gauges are calculated so that both inner and outer tubes will attain the same long life. The wall thickness of the component tubes in Duplex is varied to meet your specific application needs as influenced by temperature, pressure, corrosion rate on the inside and outside. You are assured a *balanced-wall* Duplex Tube, with improved safety factor, which makes practical use of every ounce of metal.

Another important benefit is the superior heat-transfer properties of Bridgeport Duplex Tube, achieved by a closer, cleaner bond on the interfaces. And, of course, by resisting different types of corrosion inside and out, they eliminate or reduce the need for frequent retubing and shutdowns, and reduce maintenance costs substantially.

Add up all these advantages, and you see that Bridgeport Duplex Tubes give consistently superior performance *and* lasting economy over a period of time. Remember, it's lifetime costs that count and Bridgeport Balanced-Wall Duplex Tubes assure lowest lifetime costs. Our Technical Service Department will be glad to recommend Duplex Tubes to match your individual service requirements.

Call your local Bridgeport Sales Office for complete information. Ask for Bridgeport's Duplex Tube Technical Bulletin.

Bridgeport Brass Co.

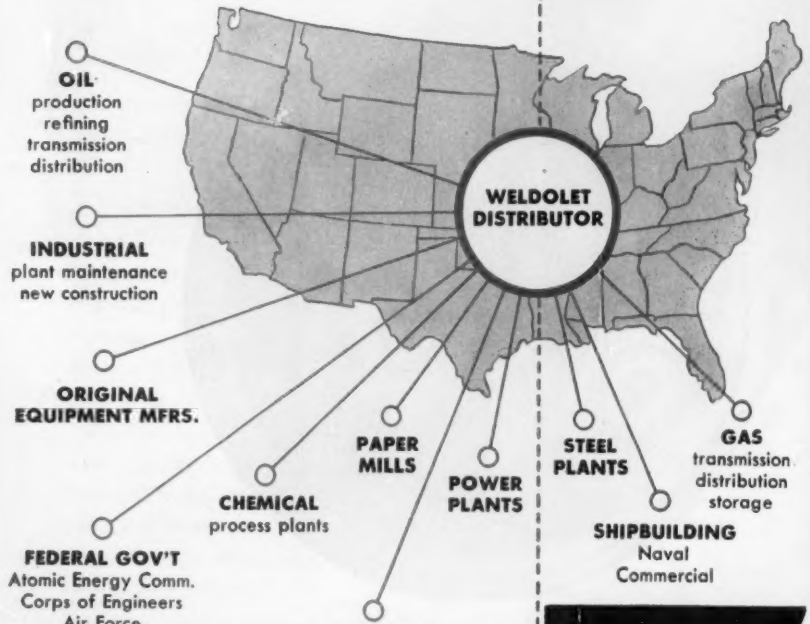
BRIDGEPORT BRASS

Offices in Principal Cities · Conveniently Located Warehouses

Bridgeport Brass Company, Bridgeport 2, Connecticut • In Canada: Noranda Copper and Brass Limited, Montreal

WELDOLET WELDING FITTINGS

serve the Nation's Industries



branch connections for any and all piping services

NOW AVAILABLE from leading warehousing distributors in all principal cities. Write for catalog W-4.

WELDOLETS

THREDOLETS

SOCKET WELDOLETS

BONNEY

WELDING FITTINGS DIVISION

FORGE & TOOL WORKS

350 GREEN ST., ALLENTOWN, PENNA.

APPOINTMENTS

Corporation executive changes

SKF Industries, Inc: Edwin R Broden, president and chief executive officer. **Minnesota Rubber and Gasket Co:** George E Carlson, president. **Cutler-Hammer Inc:** G S Crane, chairman of the board; Philip Ryan, president and chief executive officer; J C Borden, vice-president and controller.

Walworth Co: D Frank Mederos, vice-president and assistant to the president. **Brooks Rotameter Co:** Seymour Blechman, executive vice-president. **Dow Corning Corp:** Olin D Blessing, vice-president. **Union Carbide Nuclear Co:** Lauchlin M Currie, vice-president.

Moloney Electric Co: C M Lovell, vice-president, engineering and research; David F Winter, vice-president and chief engineer. **Crouse-Hinds Co:** Albert H Clarke, vice-president, engineering. **The Cooper - Bessemer Corp:** Robert F Lay, vice-president and general sales manager. **Borg-Warner Corp:** A W Rose, vice-president and general manager of Petro-Mechanics Research Div; M R McLary, vice-president of Ingersoll Products Div; Robert F Schutz, vice-president and manager of Ingersoll Kalamazoo Div.

Engineer changes

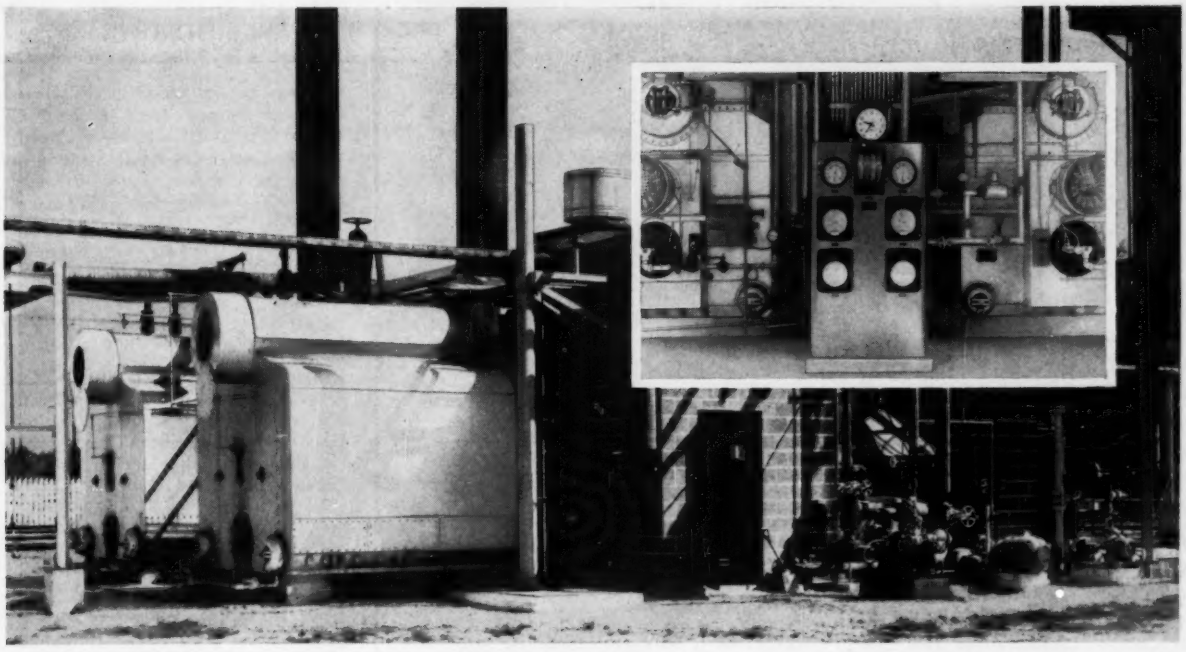
Thomas A Edison Inc: Robert S Buritz, chief project engineer, instrument div. **Allis-Chalmers Manufacturing Co:** Albert Ewy, chief engineer, switchgear assemblies; **Frank T Gifford**, chief engineer, circuit breakers. **Worthington Corp:** W C Osborne, manager of engineering, Harrison Div.

Klipfel Valves, Inc: Nikolai Belaef, chief engineer. **Sterling Electric Motors, Inc:** A J Allcock Jr, chief staff engineer. **Wagner Electric Corp:** Paul C Ford, chief engineer, electrical div. **Leslie Co:** Sten Soderberg, director of engineering. **Barry Controls Inc:** Edward J Lunney, chief engineer, research and analysis dept.

New sales managers

Westinghouse Electric Corp, Sturtevant Div: Alexander Martin, field sales manager; Philip Cohen, marketing services manager; Robert Mercer, northeastern regional manager; Hiram W Rainey Jr, central regional manager. **General Motors Corp,** Detroit Diesel Engine Div: Robert E Hunter, general sales manager. **The Jeffrey Manufacturing Co:** Chester G Hawley, general sales manager, industrial div. **Allis-Chalmers Manufacturing Co:** D W Webb, manager of sales, switchgear assemblies and unit substations; William G Lewis, manager of sales, circuit breakers.

The Electric Products Co: Harvey



Two Union packaged boilers play important role in Davison cracking catalyst plant

Job Report (UIW) — Proving that they can do their job outdoors as efficiently as indoors, two Union Type MH Steam Generators handle a key assignment for Davison Chemical Company, Division of W. R. Grace & Co. They deliver process steam in Davison's large Lake Charles, La. plant which is equipped to produce approximately 45,000,000 lbs. of petroleum cracking catalysts annually.

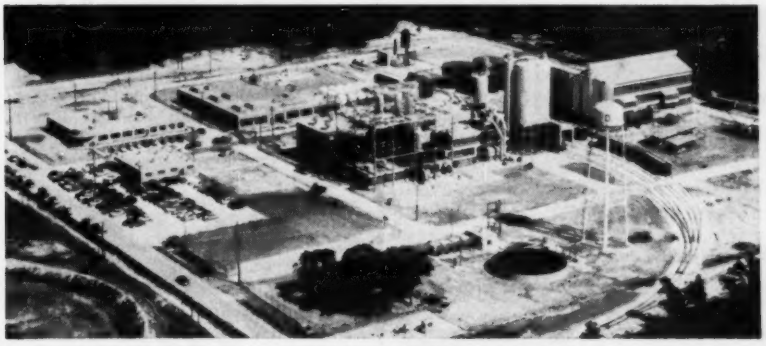
Selected for this important role because of "reputation . . . and delivery," these Union Packaged Steam Generators are reported by Davison to be operating at high efficiency.

Each of the pair has a steam capacity of 18,000 lbs/hr. at 250 psi and is gas fired. Both were completely assembled in Erie, Pa. by Union Iron Works before delivery to their Louisiana job site.

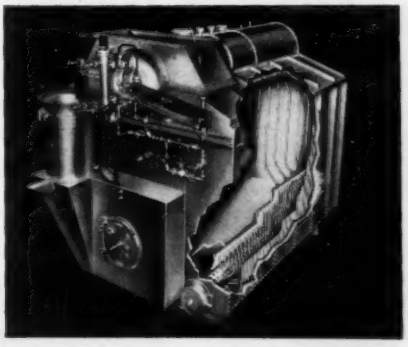
Patterned after larger but similar field erected Type H Boilers, originated by Union over 16 years ago, numerous MH Packaged Units are being installed in chemical processing plants, pulp and paper mills, breweries, refineries, institutions, schools and hospitals.

With standard units designed in 13 sizes from 10,000 to 40,000 lbs/hr. at 250 psi, Union Packaged Steam Generators can be equipped to handle multitudes of needs formerly requiring costly field erection. For example: Superheaters can be installed to meet total temperature requirements, while air heaters and economizers are readily supplied when needed. High pressure units are also available for special applications.

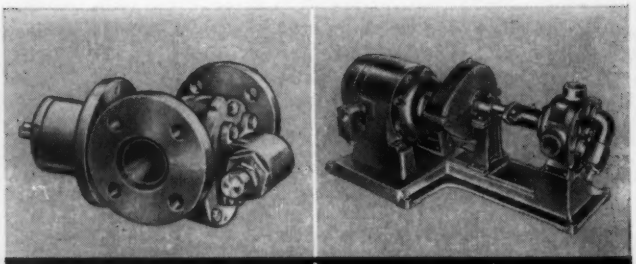
The complete story of Union Type MH Steam Generators, including cut-away illustrations, tube layouts and dimension tables, can be obtained promptly by requesting Bulletin MH-353 from Union Iron Works, Erie, Pa.



Aerial view of Davison Chemical Company's large Lake Charles, La. plant for manufacture of petroleum cracking catalysts.



Cutaway of compact Union Type MH Steam Generator. Tubes arranged for straight-through gas flow with low draft loss.



CUSTOM BUILT
TO YOUR SPECIFICATIONS

STANDARD MODELS
IN A COMPLETE LINE

NEED PUMPS to fit your machine or individual pumping units?

VIKING HAS THEM

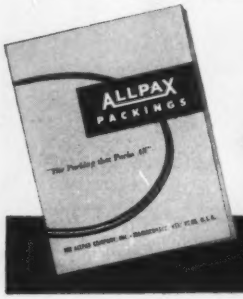
Here's how to make sure you have the right pump for each job. Let Viking engineers help you choose. With 750 catalogued models PLUS thousands of special models available, Viking can fit your need. Capacities range from ½ to 1050 gallons per minute. Whether you want to pump a light, highly-volatile liquid or a heavy, semi-solid type, Vikings will give you smooth, positive action. For more information, write for catalog 56Sw today.

VIKING PUMP COMPANY
Cedar Falls, Iowa, U.S.A. In Canada, it's "*ROTO-KING*" pumps
See our catalog in Sweets

RADIUS UNLIMITED

with the ALLPAX Extension Gasket Cutter

There is no gasket too large to be cut with the Allpax Extension Gasket Cutter. With the simple addition of extra 6" extension arms, the radius can be increased as required. Without extensions this handy, versatile tool cuts diameters from ¼" to 12".



Make replacement gaskets quickly and easily with the Allpax Extension Gasket Cutter and avoid costly delays in operation.

SEND FOR OUR NEW CATALOG TODAY!
See our complete line of packings, tools, and gasket materials. Contact our distributor or write to:

THE ALLPAX COMPANY
805 Mamaroneck Ave. • Mamaroneck, N. Y.

More APPOINTMENTS

Begins on page 234

B Wilgus, general sales manager. **Dean Brothers Pumps Inc:** Richard C Bierck, general sales manager. **Borg-Warner Corp:** Donald R Spotz, general sales manager, Pesco Products Div. **Gibson Electric Co:** Malcolm Anderson, sales manager. **Tuthill Pump Co:** A L Caney, general sales manager. **Leslie Co:** Russell W Boettiger, director of sales.

New sales engineers

Dravo Corp: John D Purdy, Chicago district; Wheeler M Bearden, Indianapolis branch. **The Cleveland Vibrator Co:** Gilbert R Stocum, Illinois territory. **Electric Machinery Mfg Co:** Norman G Selland, New York City office; Robert O Bresee, Buffalo territory. **Borg-Warner Corp:** W O W Smith Jr, Rockford Clutch Div, headquarters in Houston.

New distributors

For **Cleaver-Brooks Co,** Burner Div: Central Burner & Equip Sales & Service, Marshfield, Wis.; E A Cornely, Inc, San Francisco, Calif.; Graham & Garretson Burner Co, Ottumwa, Iowa; Hev-E-Oil Burner Sales Co, Hingham, Mass.; John Kalmacoff Agency, Victoria, B.C., Canada; Larry & Chuck's Heating Service, Portland, Ore.; Gordon Latham, Ltd, Vancouver, B.C., Canada; T E Matthews & Brother, Martinsburg, W. Va.; Harry E Nason, Auburn, Me.; Mathews Sales & Service, Inc, Portland, Me.

For **Ampco Metal, Inc.:** Will Process Equipment Corp, Rochester, N. Y.; The Condit Co, Tulsa, Okla.; A-L Machine and Equipment Co, Franklin Park, Ill.; Rawdon Myers Agency, Cincinnati, Ohio; Paul B Duggan, Chicago, Ill. For **Automatic Switch Co:** Baker Specialty and Supply Co, Inc, 701 Erie Ave, Logansport, Ind.; Vermont Hardware Co, Inc, Burlington, and White River Junction, Vt.

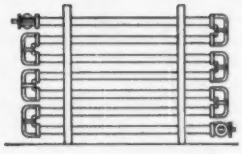
New representatives

For **Condenser Service & Engineering Co:** Merrill & Co, 407 S Dearborn St, Chicago, Ill. For **Young Radiator Co:** Sarco Co, Inc & Sarcotherm Controls Inc, Empire State Bldg, New York 1, N. Y. For **National Research Corp:** Carter C Chinnis, Washington, D.C. For **Hills-McCanna Co:** Paul B Mueller Co, 823 Metropolitan Bldg, Minneapolis 1, Minn.

For **Cleaver-Brooks Co:** Erickson Industrial Products Co, 6234 Peeler St, Dallas 19, Texas. For **Induction Motors Corp:** Wells-White Co, 6625 Delmar Blvd, St Louis 5, Mo. For **Armstrong Machine Works:** Award Engineering Co, 906 Niagara, Buffalo 13, N. Y.; Power Specialties Co, Inc, 171 Broadway, Arlington 74, Mass. For **Barber-Colman Co,** Wheelco Instru-

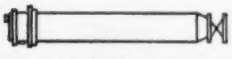
Another reason why,
EBKO *is best for complete piping service . . .*

EBKO piping systems can save you thousands of dollars



Stack Heat Exchangers

Line Type Heat Exchangers



Suction Heaters

• EBKO custom designed piping systems are the absolute highest of quality, made with the finest of materials, sold at competitive prices. The keynote of EBKO design is simplicity. Here are some reasons why EBKO should be your first and last choice:

INSTALLATION EASE. EBKO pipe is built stronger than any other prefabricated pipe. Long lengths can be assembled on the ground and raised or at the side of the trench, then lowered. No special handling methods or tools and no special structural supports are needed.

DURABILITY. Never has an EBKO prefabricated piping system failed. EBKO piping joints, both *interior* and *exterior*, can be tested and visually checked after each is assembled. Before you backfill the trench you know the job is sound.

ENGINEERING SERVICE. EBKO engineers will give job-site service prior to and during installation. These are highly trained, experienced men in all phases of piping.

DELIVERY. The simplicity of EBKO design means complete systems can be assembled and shipped in the very minimum of time.

NATIONWIDE SERVICE AND SALES. Factory representatives in every major city are located throughout the United States to answer any question that may arise.

. . . there are many, many more reasons why EBKO should be your first and last choice. Call your local EBKO Representative and let him show you how to cut your piping system costs. Write for details—no obligation.

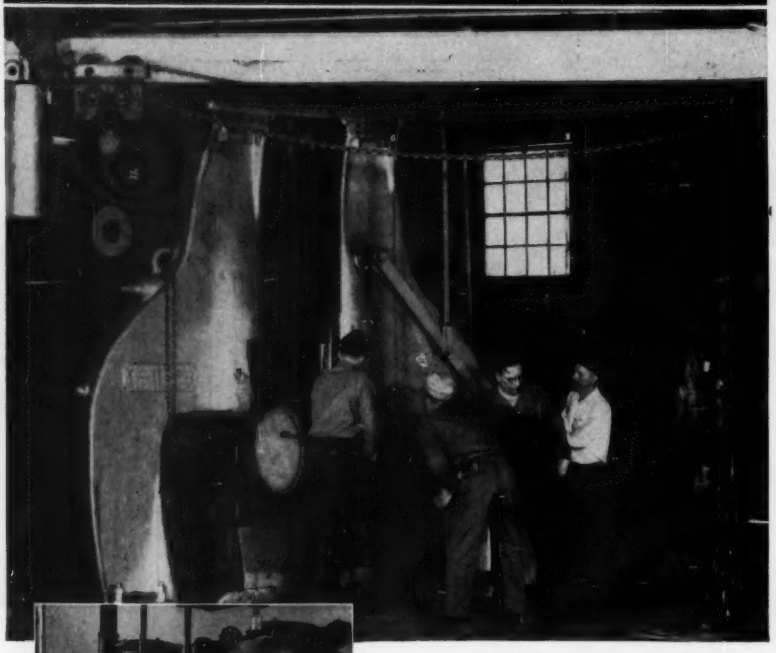
Cast Iron Steel

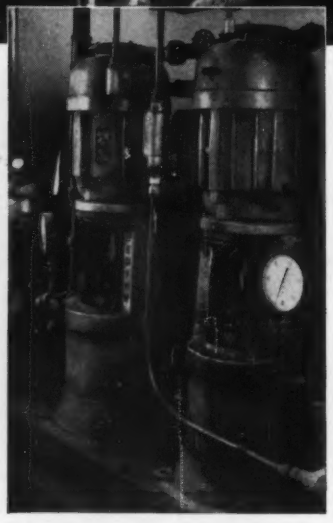
EBKO
Complete Prefabricated Piping Systems

E. B. KAISER CO.
Since 1890
2112 West Lake Avenue • Glenview, Illinois
Phone: Glenview 4-4500

FOR STEAM • HIGH TEMPERATURE WATER • CHILLED WATER • VISCOUS LIQUIDS

DEMING PUMPS
help make forgings...





● Powerful forge machines produce steel forgings at the McInnes Steel Company, Corry, Pa. These machines are operated by steam power at 135 lbs. pressure.

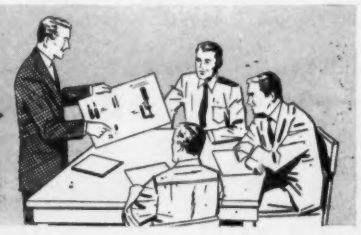
Two Deming Vertical Pumps, working alternately, supply water for the boilers. Dependable, low cost operation and easy accessibility for maintenance make these compact Deming Pumps ideal for boiler feed service.

Above view shows the two Deming Vertical Pumps installed at the McInnes Steel Company, Corry, Pennsylvania.

Today's line of Deming Industrial Pumps includes more types, sizes and capacities than ever before.

THE DEMING CO. • 547 BROADWAY • SALEM, OHIO

CALL YOUR* DEMING DISTRIBUTOR *for help on pumps!



More APPOINTMENTS

Begins on page 234

ments Div: Grant Edgel Co, 8714 NE Siskiyou St, Portland 20, Ore. For **S Morgan Smith Co:** Moody-Price, Inc, PO Box 4587, Audubon Station, Baton Rouge, La.

Recent purchases, mergers

Link-Belt Co, exchange of shares with Syntron Co which will operate as a Link-Belt subsidiary. **Vitro Corp,** purchase of Refinery Engineering Co which will become a wholly-owned subsidiary of Vitro, together with its Canadian subsidiary, Refinery Engineering, Ltd. **Blaw-Knox Co,** purchase of Continental Foundry & Machine Co. **H K Porter Co, Inc:** acquisition of Henry Disston & Sons, Inc and Carlson & Sullivan, Inc. **Canton Stoker Corp:** purchase of assets of Wagener Steam Pump Co.

Association elections

Conveyor Equipment Manufacturers Association: E E Boberg, president; J H Walker, vice-president; Adrian W Rich, treasurer; H E Murken, secretary. **National Electrical Manufacturers Association:** J W Corey, president; F F Loock, J J Mullen Jr, B C Neece, W V O'Brien and J L Singleton, vice-presidents; Arthur A Berard, treasurer. **Stoker Manufacturers Association:** L C Dubs, president; W B Baer, vice-president; Emmett J Worley, secretary-treasurer.

Retirements

Robert S Fleshiem, assistant to vice-president in charge of industries group, Allis-Chalmers Manufacturing Co, after more than 50 years of service.

Ward F Davidson, research engineer, Consolidated Edison Co of New York, after 33 years of service.

Robert Whyte, head of national sales of grating and stair treads, Dravo Corp, after 24 years of service.

Ralph H Tyrell, vice-president and board member, The Stalwart Rubber Co, after 23 years of service.

Carl H Bissell, vice-president, engineering, Crouse-Hinds Co, after 53 years of service.

Charles P Potter, chief engineer, electrical division, Wagner Electric Corp, after 46 years of service.

H F Vogt, board chairman, Cutler-Hammer, Inc, after 56 years of service.

Obituaries

Gerald G Lipke, sales manager, standard products, Hagan Corp, on Nov 1.

David Milton Allan, secretary, manager of Philadelphia sales district, The Anchor Packing Co, on Nov 12.

Herbert C Gross, 66, manager of Delaware division, Philadelphia Electric Co, on Nov 23.

he's working for you

THIS FELLOW IS TRAINED IN YOUR BUSINESS. His main duty is to travel the country — and world — penetrating the plants, laboratories and management councils . . . reporting back to you every significant innovation in technology, selling tactics, management strategy. He functions as your all-seeing, all-hearing, all-reporting business communications system.

THE MAN WE MEAN IS A COMPOSITE of the editorial staff of this magazine. For, obviously, no one individual could ever accomplish such a vast business news job. It's the result of many qualified men of diversified and specialized talents.

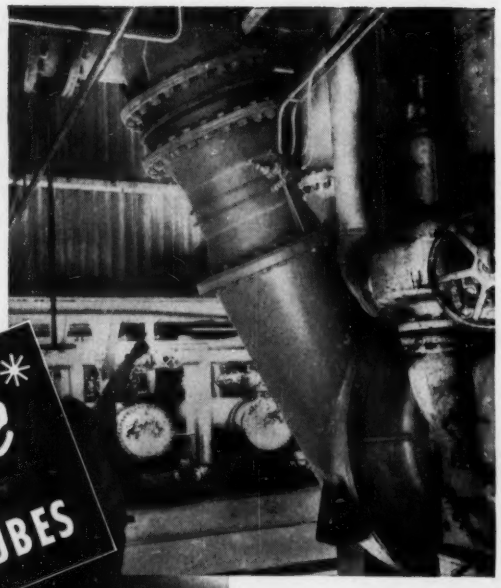
AND, THERE'S ANOTHER SIDE TO THIS "COMPOSITE MAN," another complete news service which complements the editorial section of this magazine — the advertising pages. It's been said that in a business publication the editorial pages tell "how they do it"—"they" being all the industry's front line of innovators and improvers — and the advertising pages tell "with what." Each issue unfolds an industrial exposition before you—giving a ready panorama of up-to-date tools, materials, equipment.

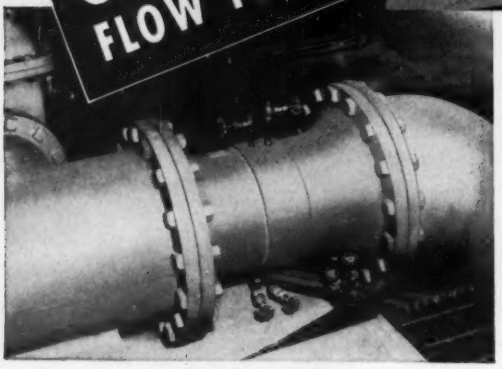
SUCH A "MAN" IS ON YOUR PAYROLL. Be sure to "listen" regularly and carefully to the practical business information he gathers.

McGRAW-HILL FOR BUSINESS

McGRAW-HILL PUBLICATIONS

PIPING LAYOUT IS SIMPLER with Gentile* FLOW TUBES





...THEY NEED SO LITTLE ROOM

Gentile Flow Tubes are short. They need only minimum straight runs entering and following, and can be installed at practically any accessible point where flow conditions are reasonably steady.

Flow Tubes are furnished with individual head capacity curves, and for unusual piping arrangements, calibration curves for simulated conditions can be furnished.

Guaranteed

- Accuracy
- Minimum Head Loss
- Reproducibility

*GEN-TIL-LY

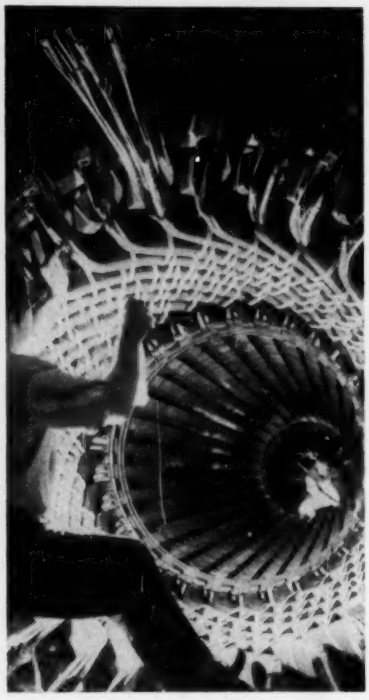
FOSTER ENGINEERING COMPANY

835 LEHIGH AVENUE UNION, N. J.

AUTOMATIC VALVES • CONTROL VALVES • SAFETY VALVES • FLOW TUBES

REPORTS from the FIELD

Begins on page 154



Windings installed for largest generator

► THESE WINDINGS will generate 250,000 kw at 24,000 volts—both record highs in this country. The high power is made possible by inner-cooling of the windings. These high-voltage stator coils are insulated with Thermalastic insulation. This is one of two 250,000, 3600-rpm generating units built by Westinghouse Electric Corp now being installed at TVA's Gallatin Station.

United Engineers to construct reactor test facilities

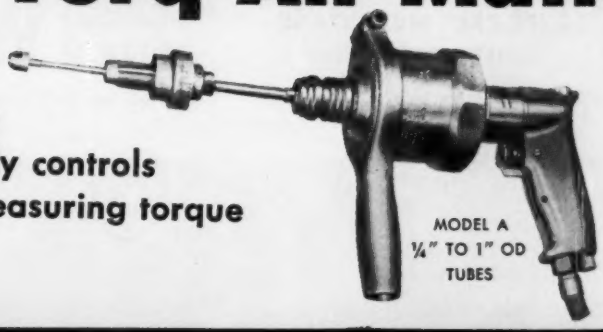
► REACTOR TEST FACILITIES for an atomic electric power plant in the Delray Power Plant of The Detroit Edison Co will be constructed by United Engineers & Constructors Inc. The Philadelphia firm has been retained by Atomic Power Development Associates, Inc, Detroit, an association of power companies, equipment manufacturers and engineering-construction firms.

While this is the first step toward a plant that ultimately will supply 100,000 kw of commercial power to the Detroit area, immediate purpose of the facility is to further study of the development of atomic power for public distribution and consumption.

The test facility will simulate operating conditions to determine optimum sizes and capacities of heat transfer equipment. The reactor that United

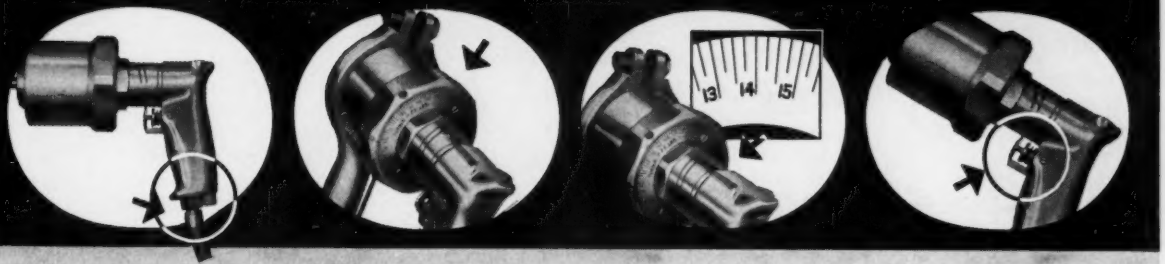
New WILSON Torq-Air-Matic

First and only air-driven tube expander drive that accurately controls tube expansion by directly measuring torque output at the mandrel.



MODEL A
¼" TO 1" OD
TUBES

Look at these exclusive design features of the WILSON Torq-Air-Matic

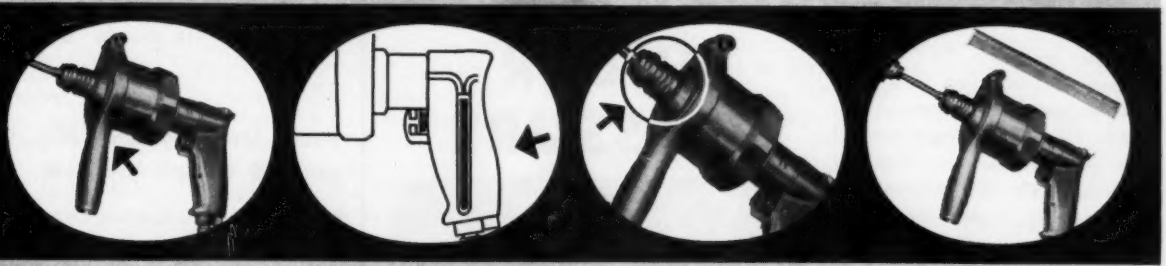


AIR-DRIVEN—Only air-driven tube expander drive with a built-in torque control. *Does not require a separate control box, relays or switches.* No extra cables or wires; just one small air hose serves it.

CALIBRATION—The only tube expander control calibrated in *terms of foot pounds torque instead of meaningless arbitrary units.* Torque requirements for expanding tubes of off-standard jobs can be more readily arrived at.

POWERFUL—Rated to deliver *fourteen foot pounds torque* at 90 psi. This is sufficient to roll 1" OD x 11 gauge boiler tubes.

SIMPLE—Only a *single three-position trigger throttle* for off, forward and reverse. Never any danger of over-rolling because of improper sequence of operation. No juggling of switches; nothing new to learn.



CONVENIENT—*Furnished with an auxiliary handle that can be swivelled to any position desired* by the operator or left off when the torque reaction is not too great. Basic unit is of a pistol grip design.

TROUBLE-FREE—*Has an oil reservoir* built into the handle to supply lubrication to the motor. *The control section is independent of the motor and lubricated for life.*

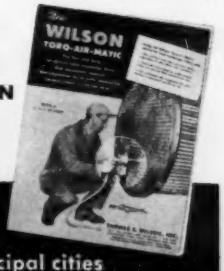
CHUCK—*Simple, new type, snap on floating chuck. Only one motion* instantly engages or disengages a square shank mandrel—no set screws.

COMPACT—*Only 10" overall* from pistol grip handle to instant action chuck.

TW 860

These features speak for themselves. The Wilson air-driven Torq-Air-Matic tube expander drive and control is an important revolutionary advance in the field of precise tube expanding. Here's what you get when you use the Wilson Torq-Air-Matic control for heat exchanger tubes: (1) uniform and tight pressure joints, regardless of tube sheet hole variation; (2) no over-rolled or under-rolled tubes—no stresses that shorten tube life; (3) extended tube expander life, more production, higher profits.

SEND FOR BULLETIN 55

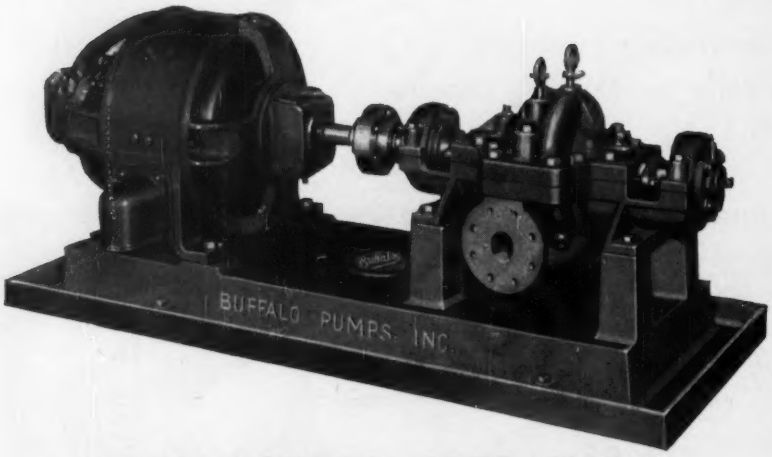


THOMAS C. WILSON, INC.

21-11 44th Avenue, Long Island City 1, New York • Representatives in all principal cities

MANUFACTURERS OF TUBE CLEANERS, TUBE EXPANDERS AND TUBE MAINTENANCE TOOLS

TYPE "RR" MULTISTAGE
BOILER FEED PUMP



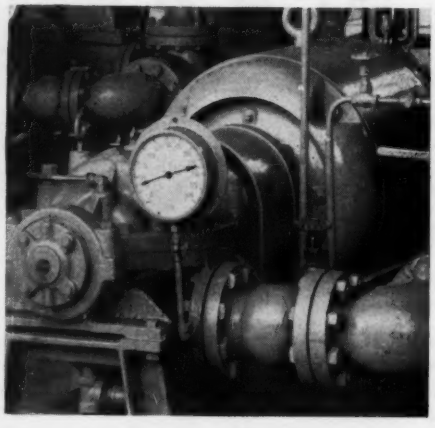
THE BOILER FEED PUMP
BUILT TO KEEP DELIVERING

Few pump jobs call for the high pressure operation required in boiler feed. Thus, pumps on this important job must have both efficiency and terrific endurance. "Buffalo" offers you both, at moderate price, in the Type "RR" Pump. Delivering at heads as high as 1500' (500 psi), these ruggedly built pumps have been proving themselves dependable and economical in hundreds of boiler rooms for many, many years.

UNDER
PRESSURE

Why not look into the "Buffalo" Q Factor* construction that makes these two and four-stage pumps your best buy? You'll find rugged strength built into every part—oversize ball bearings, shafts and efficient impellers—heavy casings with free-flow water passages — rigid, substantial pump stands. WRITE FOR BULLETIN 980-C TODAY, and check the features that will mean lower cost per gallon for you, year after year!

The "Q" Factor—the built-in Quality which provides trouble-free satisfaction and long life.



"Buffalo" PUMPS

BUFFALO PUMPS
DIVISION OF BUFFALO FORGE COMPANY
488 BROADWAY • BUFFALO, N.Y.
Canada Pumps, Ltd., Kitchener, Ont.
Sales Representatives in all Principal Cities

A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

REPORTS from the FIELD

Begins on page 154

Engineers has been commissioned to build for the test facility will also be used in the permanent power plant that will be started when tests are completed and assessed. The four million dollar project is scheduled for completion in 1956.

POWER'S History

► POWER was founded in 1884 by E P Harris and H M Swetland. With it was incorporated *Steam*, which had been started by N Hawkins in Chicago two years earlier.

In 1903 POWER purchased and absorbed *Science and Industry*, which was a consolidation of a number of periodicals, namely, *Home Study Magazine*, *Home Study for Machinists*, *Mechanic's Magazine*, *Home Study for Building Trades*, *Building Trade's Magazine*, *Home Study for Electrical Workers* and *Steam Electric Magazine*.

In 1908 POWER absorbed *The Engineer's Review*, of Cleveland, and *The Engineer*, of Chicago, the latter being a consolidation of *The Safety Valve*, *Lord's Power and Machinery Magazine*, *The Stationary Engineer*, *Steam Engineering* and *The Mechanical Engineer*. When *The Engineer* was purchased, the name of the combined magazine was *Power and the Engineer*. The title was condensed to POWER in 1911.

In 1951, POWER absorbed *Operating Engineer*. All rights to the above titles reserved.

Strong Steam Specialty Mfg. Co names R L Clark president

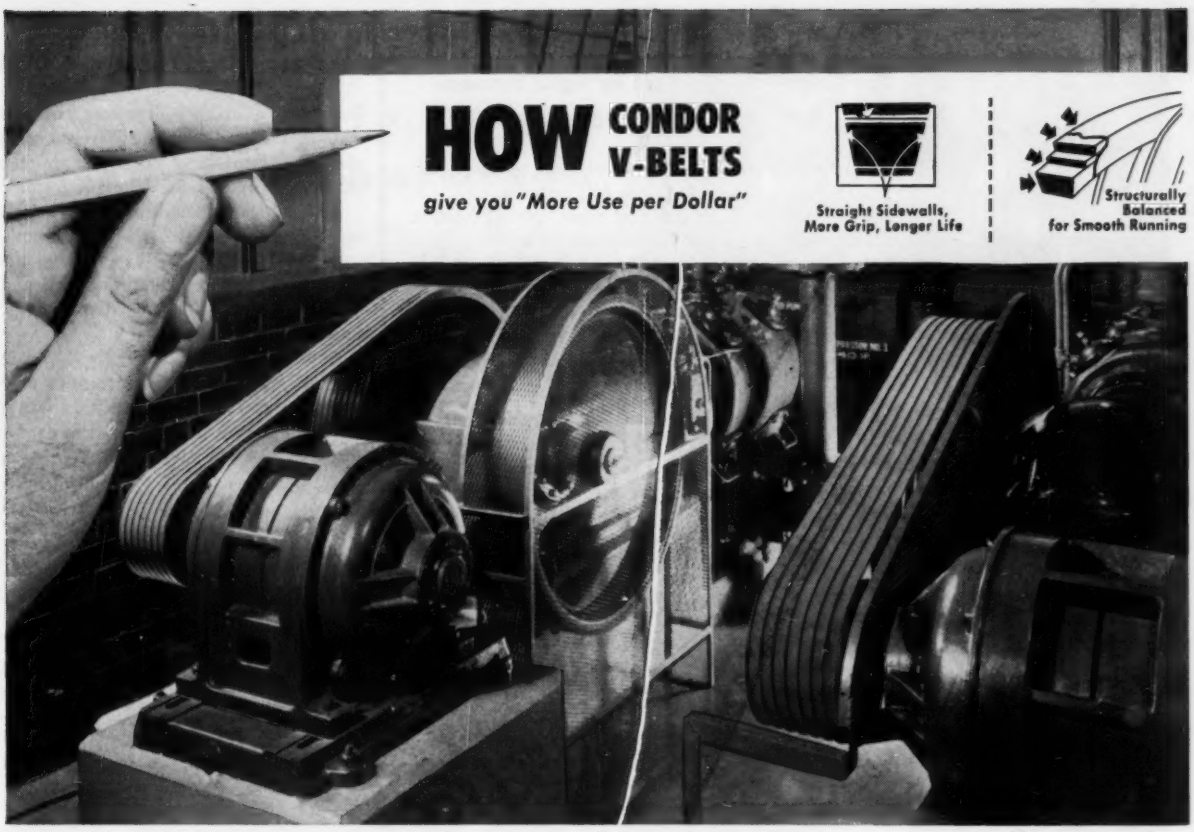
► ELECTION OF R L Clark as president of Strong Steam Specialty Mfg Co, wholly owned subsidiary in Conneaut, Ohio of Strong, Carlisle & Hammond Co, has been announced.

Clark will be responsible for engineering, research, development and production at Conneaut. He has been with Strong, Carlisle & Hammond since 1920.

At the same time, it was announced that H H Maltbie has been promoted to sales manager for the steam specialty division of Strong, Carlisle & Hammond. He will direct national marketing of steam specialties.

Wire and cable being shipped on non-returnable reels

► A PROGRAM of making shipments of certain types of wire and cable on non-returnable reels has been adopted by Anaconda Wire and Cable Co. Initially, the program will be more or less confined to shipments of building wire


HOW CONDOR V-BELTS
give you "More Use per Dollar"
Straight Sidewalls, More Grip, Longer Life
Structurally Balanced for Smooth Running

These Smoother Running V-Belts Lower Your Operating Costs

Condor V-Belt engineering makes the difference. The strength member is micro-positioned in heat dissipating rubber for a smoother running, cooler running drive . . . for longer life with the heaviest power loads. Condor V-Belt sidewalls are made *straight* to put positive pressure on the sheave grooves for more grip . . . less slip. Straight sidewalls help support the super-strength synthetic cords of the belt in a straight line so that *all* cords pull equally . . . deliver their maximum share of power. Controlled length is accomplished through prestretching during manufacture to remove inelastic stretch that might otherwise occur on the job.

NOW . . . Moisture-Proof Vacuum Packaging

R/M's exclusive new vacuum sealed moisture-proof packaging assures positive V-belt length control for users of longer lengths in C, D & E cross sections! Belts are measured at the factory under controlled humidity and identified for precise matching. They are then vacuum-sealed in moisture-proof aluminum lined bags. The result—no shrinkage or elongation in storage . . . sustained uniformity on the drive! Length is certified from the factory to the field.

R/M Poly-V* Drive

A New Belt Drive Concept For Heavy-Duty Power Transmission. Eliminates V-belt matching problems. Delivers up to 50% more power in the same space as regular V-belts or equal power in less space.

Write for copy of Poly-V Drive Bulletin #6638.

(*Poly-V is a registered Raybestos-Manhattan trademark)

RM-106

MANHATTAN RUBBER DIVISION—PASSAIC, NEW JERSEY

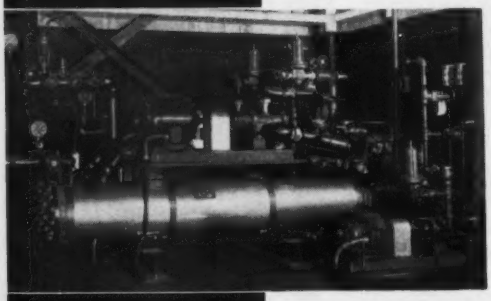
RAYBESTOS-MANHATTAN, INC.

Other R/M products include: Industrial Rubber • Fan Belts • Radiator Hose • Brake Linings • Brake Blocks • Clutch Facings Asbestos Textiles • Packings • Engineered Plastic, and Sintered Metal Products • Laundry Pads and Covers • Bowling Balls

ENCO
Fuel Oil Pumping and Heating Systems

For heavy bunker oil or light furnace oil . . . 100 to 10,000 gallons per hour

Enco systems employ one, two or more pumps and heaters, interconnected so that full capacity is possible with any combination of pumps and heaters. Flexibility of design permits the use of any combination of rotary pumps, with motor or turbine drive; or piston type steam pumps. Any part may be cut out of operation for inspection or cleaning, without shutting down, where two or more pumps and heaters are included in the unit system.



Heaters are insulated and jacketed with removable heads at both ends for cleaning without breaking any piping connections or removing any tube bundles.

Full automatic oil pressure and temperature control, with relief valves for each pump and heater. Permits delivery of oil with safety, and at proper temperature and pressure for efficient burning.

Each unit is built to order and delivered ready to place on foundation and for connection to the station piping.

Write for Bulletin OB-53 describing Enco Gas and Oil Burners; and Pumping and Heating Equipment.

THE ENGINEER COMPANY
75 WEST STREET
NEW YORK 6, N. Y.

EC 508

FOR REPLACEMENTS ORDER HIGH PRESSURE
GAGE GLASSES
MAGNIFYING RED LINE

MASTER STANDARD RED LINE & CLEAR *Up to 500 lbs.*

MASTER CLEAR & RED LINE EXTRA STRONG *Up to 600 lbs.*

Made in Lengths up to 144" Long
And Outside Diameters ⅜", ½", ⅝", ¾", ⅞", 1", 1¼", 1½".

High Pressure Composition
ERNST RUBBER GASKETS
All sizes to fit your gages and valves

FIG. 21—Lip Mold

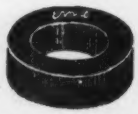


FIG. 22—Standard

ERNST WATER COLUMN & GAGE CO.
Send for Catalog LIVINGSTON, N. J.

Only
Power

writes, publishes and reprints *Special* Reports about the separate and distinct segments of the power field.

For the best condensed information on lubrication, pumps, air conditioning, and the other power services, write for POWER's reprint folder.

Write to
Power
330 West 42nd St., New York 36, N. Y.

REPORTS from the FIELD

Begins on page 154

items to distributors' stocks and to aluminum insulated and covered conductors. Experience will dictate the ultimate scope of the new program.

The types of non-returnable reels used by Anaconda have withstood commercial shipments to all sections of the United States over the past year and have proven adequate on all occasions, according to the company.

Some of the benefits that will accrue to the customer in this program are: (1) elimination of reel deposit charges (2) elimination of clerical records for maintenance of reel data (3) reduction of storage space (4) reduction in overall weight and (5) elimination of reel returns to manufacturer.

Calendar of Events

Jan 23-25—American Society of Heating and Air-Conditioning Engineers, Inc, Annual Meeting, Cincinnati, Ohio. Complete information from ASHAE, 62 Worth St, New York 13, N. Y.

Jan 23-26—Plant Maintenance & Engineering Show. Convention Hall, Philadelphia. Details from Clapp & Poliak, Inc, 341 Madison Ave, New York 17, N. Y.

Jan 26-27—Engineers Joint Council, 2nd Annual General Assembly. Hotel Statler, New York. Details from EJC, 29 W 39th St, New York 18, N. Y.

Jan 30-Feb 3—American Institute of Electrical Engineers, Winter General Meeting. Hotel Statler, New York. Complete information obtainable from AIEE, 33 W 39th St, New York 18, N. Y.

Feb 1,2—Second Annual Midwest Welding Conference, sponsored jointly by Illinois Institute of Technology and the Chicago section of American Welding Society. To be held at Armour Research Foundation, Chicago. Details from IIT, 35 W 33rd St, Chicago 16, Ill.

Mar 8-9—American Institute of Electrical Engineers, Conference on Electrical Engineering As Applied to the Paper and Pulp Industry. University of Florida. Gainesville, Fla. Details from AIEE, 33 W 39th St, New York 18, N. Y.

Mar 12-16—National Association of Corrosion Engineers, 12th Annual Corrosion Conference. Hotel Statler, New York. Full information from NACE, 1061 M & M Building, Houston 2, Texas.

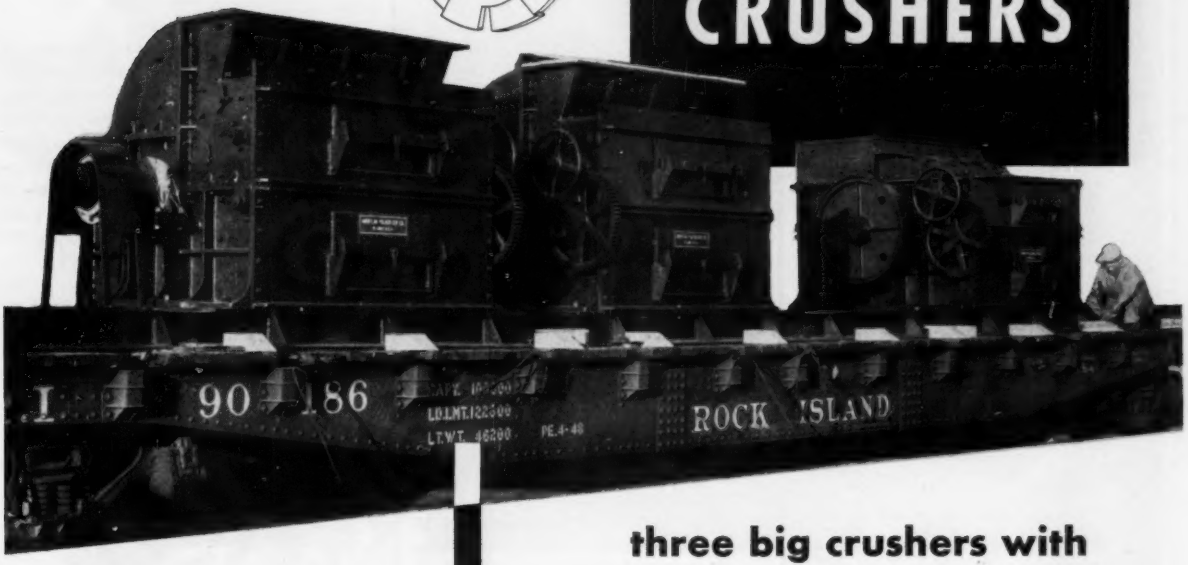
Mar 15-16—Steel Founders' Society of America, Annual Meeting. Drake Hotel, Chicago. Details from SFSA, 920 Midland Building, Cleveland 15, Ohio.

(*Continued on page 246*)

on their way
to better
coal preparation

COAL IS SPLIT
·NOT CRUSHED

"AC"
ROLLING RING
COAL CRUSHERS



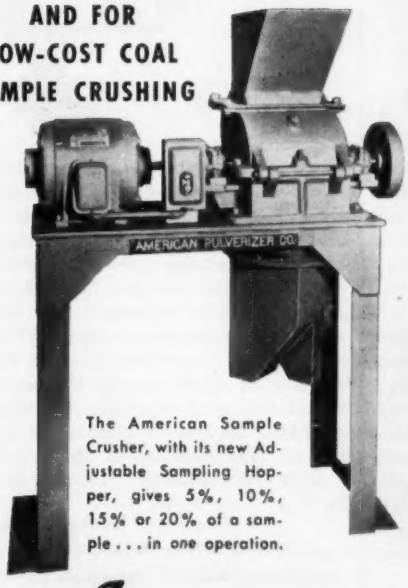
three big crushers with
the 'BIG THREE' advantages

1 **BETTER REDUCTION.** The exclusive American Rolling Ring reduction principle . . . designed to *split* coal instead of crushing it. Result: *controlled uniformity* in all coal reduction.

2 **HIGHER TONNAGE.** A "big appetite" (up to 800 t.p.h., depending on size of feed and product desired) in a *compact unit* with minimum headroom requirements for easier installation.

3 **LOWER MAINTENANCE.** Not a mere claim, but actual performance, backed by the operation records of scores of coal mines and power plants all over the country—records that prove Americans operate at a *total cost of less than 1¢ per ton of coal crushed!*

AND FOR
LOW-COST COAL
SAMPLE CRUSHING



The American Sample Crusher, with its new Adjustable Sampling Hopper, gives 5%, 10%, 15% or 20% of a sample . . . in one operation.

● ***WANT MORE INFORMATION***
on better coal preparation?
Write for Bulletin AC.

American
PULVERIZER COMPANY

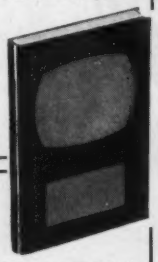
Originators and Manufacturers of Ring Crushers and Pulverizers

1349 MACKLIND AVE. • SAINT LOUIS 10, MO.

DIESEL OPERATOR'S GUIDE

Just Published!

Practical guide to quick, efficient maintenance and operation of all types of two-cycle and four-cycle diesel and dual-fuel engines used in automotive, locomotive, stationary, and marine installations. Tells how to recognize engines' trouble symptoms, how to diagnose their cause, how to remedy the defect and how to prevent its recurrence. **By C. M. Jones. 384 pp., 390 illus., $6.50**



POWER PLANT MANAGEMENT

Just Published!

Practical guide to effective management thinking in all aspects of producing dependable power at lowest cost. Covers a wide range of topics, from purchasing and use of equipment, and its safe and efficient operation, to hiring, training, and supervision of operators. Shows how objectives, costs, and equipment characteristics should be correlated and evaluated to determine best course of action. Gives yardsticks for measuring effectiveness of management and supervisory performance. **By R. H. Emerick, Consulting Engr., 339 pages, 6x9, 74 illus., $6.50**

CONNECTING AND TESTING DIRECT-CURRENT MACHINES

Manual of methods of reconnecting d-c machines for changes in voltage and speed and locating and repairing faults in the armature and field windings. Emphasizes why as well as how of various methods, demonstrates their application in typical problems, and includes many useful winding diagrams. Third Edition includes facts on modern insulations and test methods. **By F. A. Annett, Contributing Ed., Power, and A. C. Roe, Manufacturing Eng., 3rd Ed., 313 pp., 211 illus., $5.00**

PREVENTIVE MAINTENANCE OF ELECTRICAL EQUIPMENT

Just Published!

Add years to the life of your electrical apparatus with these sound methods for preventing, finding, and correcting electrical troubles. Gives specific ways for better operation and maintenance of electrical equipment—to help avoid breakdowns, reduce accidents, and make for more efficient performance. Shows how to find and identify common electrical troubles, and make emergency repairs. **By C. I. Hubert, Assoc. Prof., and Chief of the Section, Elec. Eng., U.S. Merchant Marine Academy, N. Y. 217 pp., 160 illus. $4.00**

—SEE THESE BOOKS 10 DAYS FREE—

McGraw-Hill Book Co., Dept. P-1
327 West 41st St., New York 36, N. Y.

Send me book(s) checked below for 10 days' examination on approval. In 10 days I will remit for book(s) I keep, plus few cents for delivery costs, and return unwanted book(s) postpaid. (We pay delivery costs if you remit with this coupon—same return privilege.)

- ☐ Jones—**Diesel Oper. Guide**—$6.50
- ☐ Emerick—**Power Plant Management**—$6.50
- ☐ Annett & Roe—**Connecting and Testing Direct-current Machines**—$5.00
- ☐ Hubert—**Preventive Maintenance of Electrical Equipment**—$4.00

(Print)
Name .....
Address .....
City ..... Zone ..... State .....
Company .....
Position .....
For price and terms outside U. S. Write McGraw-Hill Int'l., N.Y.C. P-1

REPORTS from the FIELD

Begins on page 154

Mar 18-21—American Society of Mechanical Engineers, Spring Meeting. Multnomah Hotel, Portland, Ore. Complete information from ASME, 29 W 39th St, New York 18, N. Y.

Mar 21-23—American Power Conference, 18th Annual Meeting. Sponsored by Illinois Institute of Technology in cooperation with 13 universities and nine national and regional technical societies. Hotel Sherman, Chicago. Details from IIT, 35 W 33rd St, Chicago 16, Ill.

Correspondence courses offered in power engineering

► THE NATIONAL ASSOCIATION of Power Engineers has arranged with the University of Wisconsin to conduct a series of correspondence courses in power engineering for its members.

The NAPE is a 76-yr-old organization dedicated to the education of the engineer or engineering aspirant. The non-profit organization has local Chapters in most of the principal cities in the United States.

Anyone in the engineering or allied fields wishing information on this educational program may apply to J D Holmes, chairman of the National Educational Committee, NAPE, c/o Magnus Chemical Co, Inc, Garwood, N. J., or to any Chapter of the Association.

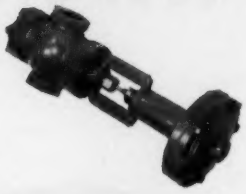
Metals pilot plant to answer need for new alloys

► A METALS PILOT PLANT designed to bridge the gap between laboratory and commercial production of new alloys and processes has been opened by the Westinghouse Electric Corp at Blairsville, Pa. The $6,000,000 facility combines under one roof virtually all types of metal processing equipment.

Need for such a plant became apparent several years ago when it was recognized that the key to advanced design in steam and gas turbines, generators, transformers, nuclear power reactors, etc was the development of new metals having better temperature, strength, and magnetic characteristics. New titanium, molybdenum, expansion and resistance alloys show particular promise in this respect.

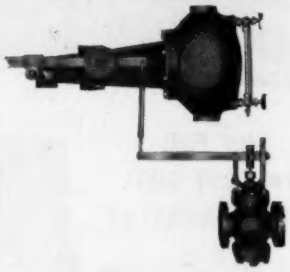
Included in the plant is an 18,000 lb and three smaller forge hammers, a 1000-ton steam-hydraulic forge press, seven forge furnaces, three induction melting furnaces varying in size to 5000 lb, a cold hearth furnace, a 1000-hp reversing hot-rolling mill, a 500-hp reversing cold-rolling mill, bell-type and

Regulating and Reducing Valves



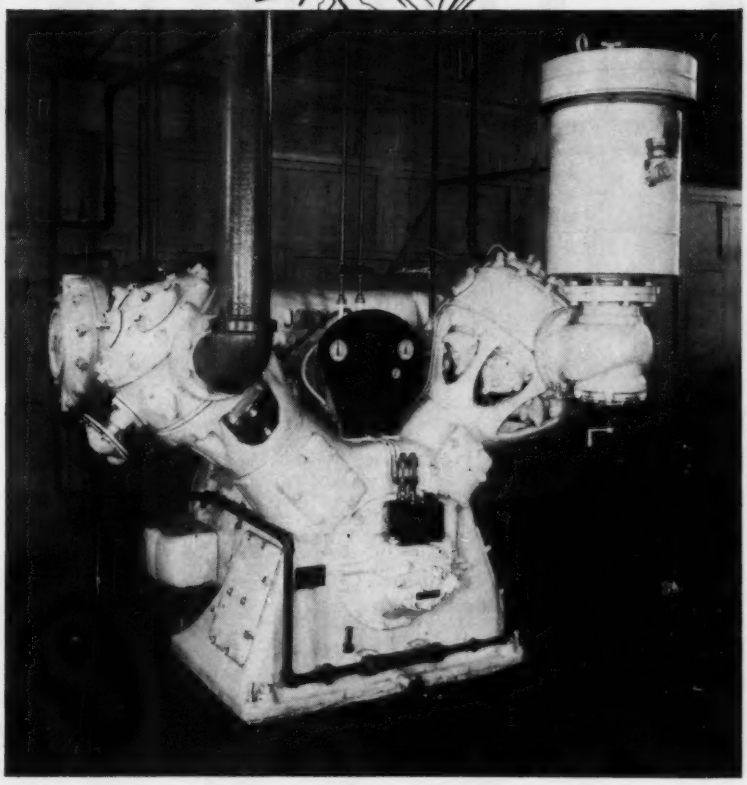
Provide automatic pressure regulation and reduction for liquid, air, steam. Used where most exacting control essential. Self-contained. Single seated, balanced; or double seated, semi-balanced. Spring or lever weight-loaded. Lever or float operated. All parts accessible without removing valve body from the line. Available in wide range of sizes and styles. Built and guaranteed by Stickle. Write for free bulletins 235 and 435.

Liquid Level Controllers



Maintain liquid level in open and closed surge tanks, receivers, hotwells, etc. Single seated, piston balanced. No wing guides in port area to cause erosion. Port area equals pipe area, making oversize valve unnecessary. Piston area equals valve area, permitting easy opening and closing. Perfectly balanced at any rate of flow or pressure. Controller is ball bearing equipped. Permits float travel up to 6". Operates any reliable make of balanced lever valve or diaphragm motor valve. Float chamber is standard semi-steel for pressures up to 125 lb.; extra heavy semi-steel for 250 lb. at 450° F. Built and guaranteed by Stickle. *Write for free literature.*

STICKLE STEAM SPECIALTIES CO.
2265 Valley Ave. • Indianapolis 18, Ind.
Specialists in Reducing the Cost of Steam—Since 1905



The Boss asked:

"WHAT'S SPOILING OUR SKILLED MECHANICS?"

. . . so I told him about our JOY WN-112 compressor

"To begin with, this two-stage, double-acting, water-cooled air compressor is small, light and efficient. V-vertical construction gives the machine excellent balance. The heavy-duty Joy WN-112 supplies dependable industrial air power—up to 125 psi with piston displacement from 368 to 974 CFM.

"And this compressor is *easy* to maintain. It has no large, heavy parts that need adjusting. Cylinder liners and cross-head guides are not an integral part of the frame. They can easily be replaced in a short time. Yes, that WN-112 is a breeze to maintain . . . and *that's* what is spoiling our skilled mechanics."

The WN-112 has two separate, protected, force-feed lubricating systems; one servicing the running gear, the other for the cylinders. Even the cross-head face is force-feed lubricated.

Joy "Dual-Cushion" valves have greatly prolonged life because of the variable reaction cushion which eliminates all pounding valve action. Truncated pistons, of strongly reinforced alloy, permit locating of valves on an angle. This insures smooth air flow and efficient head cooling.

All flange-mounted motors for Joy compressors are built to Joy specification. Floor space and foundation requirements, already minimized by the compressor's package design, are 50% less with the flange-mounted motor. The WN-112 is adaptable to other drives if desired.

For complete details, write ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.*** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

Write for Bulletin 37-16

Consult a Joy Engineer

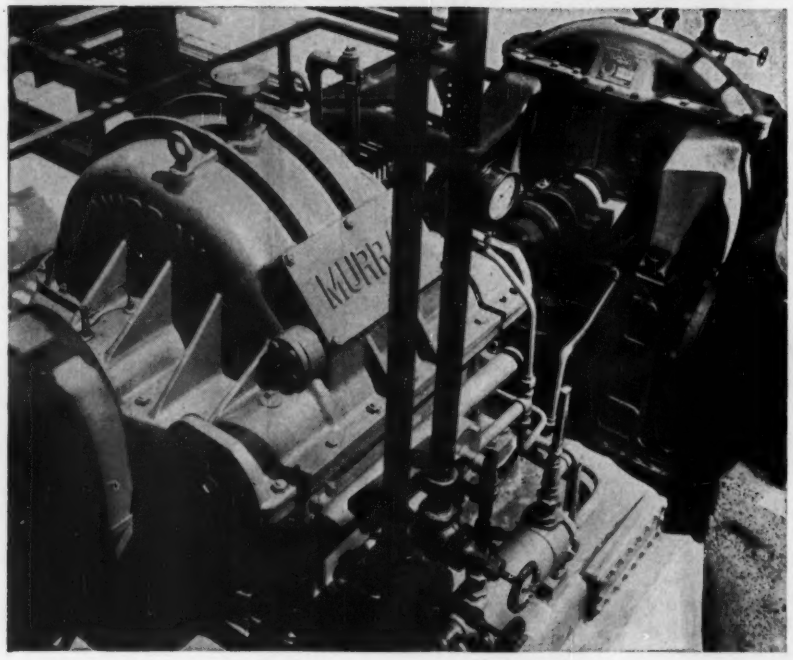
For Air and Gas Compressors, Oxygen and Nitrogen Generators, Vacuum Pumps and Boosters, Conveyors, Fans, Electrical Connectors, Hydraulic Fittings and Hose Assemblies.

WSW 15909-37

JOY

SPECIALISTS IN THE COMPRESSION AND MOVEMENT OF AIR AND GASES SINCE 1885

Murray Turbines



One of 4 Murray type U turbo-gear units installed in a southwest rubber plant still giving trouble free service after 12 years in an unprotected outdoor location. This unit drives an Induced Draft Fan requiring 425 HP at 683 RPM. The turbine speed is 3500 RPM.

● MURRAY turbo-gear units for mechanical drive are right at home in difficult outdoor installations. Fans, pumps, compressors, and many special types of slow speed machines are among the long list of installations powered by Murray turbo-gear units.

Murray gears are of the Herringbone or Double Helical type and all are pressure lubricated at the point of tooth contact.

MURRAY IRON WORKS COMPANY

BURLINGTON, IOWA

Builders of Steam Power Equipment for Three Quarters of a Century

REPORTS from the FIELD

Begins on page 154

roller-rail box-type electric furnaces, a shot pouring facility, shell mold and lost wax investment casting facilities, arc furnaces and other equipment.

High on the list of Blairsville projects is further development of these alloys: Discaloy, Refractaloy, K-42-B. Hipernik, Hiperco, Hipersil and Kovar. First three of these are high-temperature alloys for use in gas and steam turbines. Here, rotors and blades must withstand stresses at extremely high temperatures and also resist corrosion and remain ductile. Hipernik, Hiperco and Hipersil are magnetic alloys used in saturable reactors, magnetic amplifiers and choke coils.

Radioactivity measurements to be taken in Ohio River

► PLANS HAVE BEEN ADOPTED by the Ohio River Valley Water Sanitation Commission to secure measurements of radioactivity at selected points in the 981-mile length of the Ohio River and at the confluence of principal tributaries. It represents a preparatory step to regular monitoring of the river in order that the Commission may be posted on changes in water quality resulting from future disposal of radioactive wastes.

CORRECTION

REPORT ON Tampa Electric Co's new Gannon Station (November 1955) said it "will be the first major utility plant in Florida and the Gulf area to burn coal."

A B Dodson, supervisor at Scholz Steam Plant of Gulf Power Co, Chattahoochee, Fla., writes to say that they have burned pulverized coal since February 1953 and now operate two pulverized-coal fired 440,000-lb-per-hr steam generators. Any other candidates for the title "first major utility in Florida and the Gulf area to burn coal"?

Kewanee-Ross Corp dissolved, two operating divisions formed

► AMERICAN RADIATOR & Standard Sanitary Corp announced that its wholly-owned subsidiary, Kewanee-Ross Corp, has been dissolved and two new American-Standard operating divisions have been formed to continue Kewanee-Ross operations.

Joseph A Grazier, president of American-Standard, said the action was taken in accordance with the Corporation's policy of divisionalizing its operations

Scandinavia increases steam capacity, cuts costs burning coal the modern way

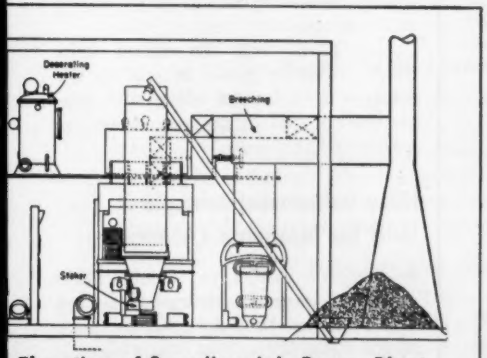
With its old power equipment overloaded by an ever-increasing demand for steam, Scandinavia Belting Co., Charlotte, N.C., took stock of its power situation. Boiler room efficiency was low and maintenance excessive; pressure fluctuated and labor costs had become a problem. Deciding to modernize, Scandinavia instituted a survey of all available fuels. On the basis of cost, coal was chosen. Today, after modernization, Scandinavia's power plant has increased steam capacity 150%, reduced fuel costs 15% and cut labor costs 70%. Increased efficiency and automatic operation have reduced the work force and assured a dependable steam supply at steady pressure with ample reserve for load growth. In addition, the cleanliness of the new plant has been an important factor in raising the morale of the employees.

facts you should know about coal

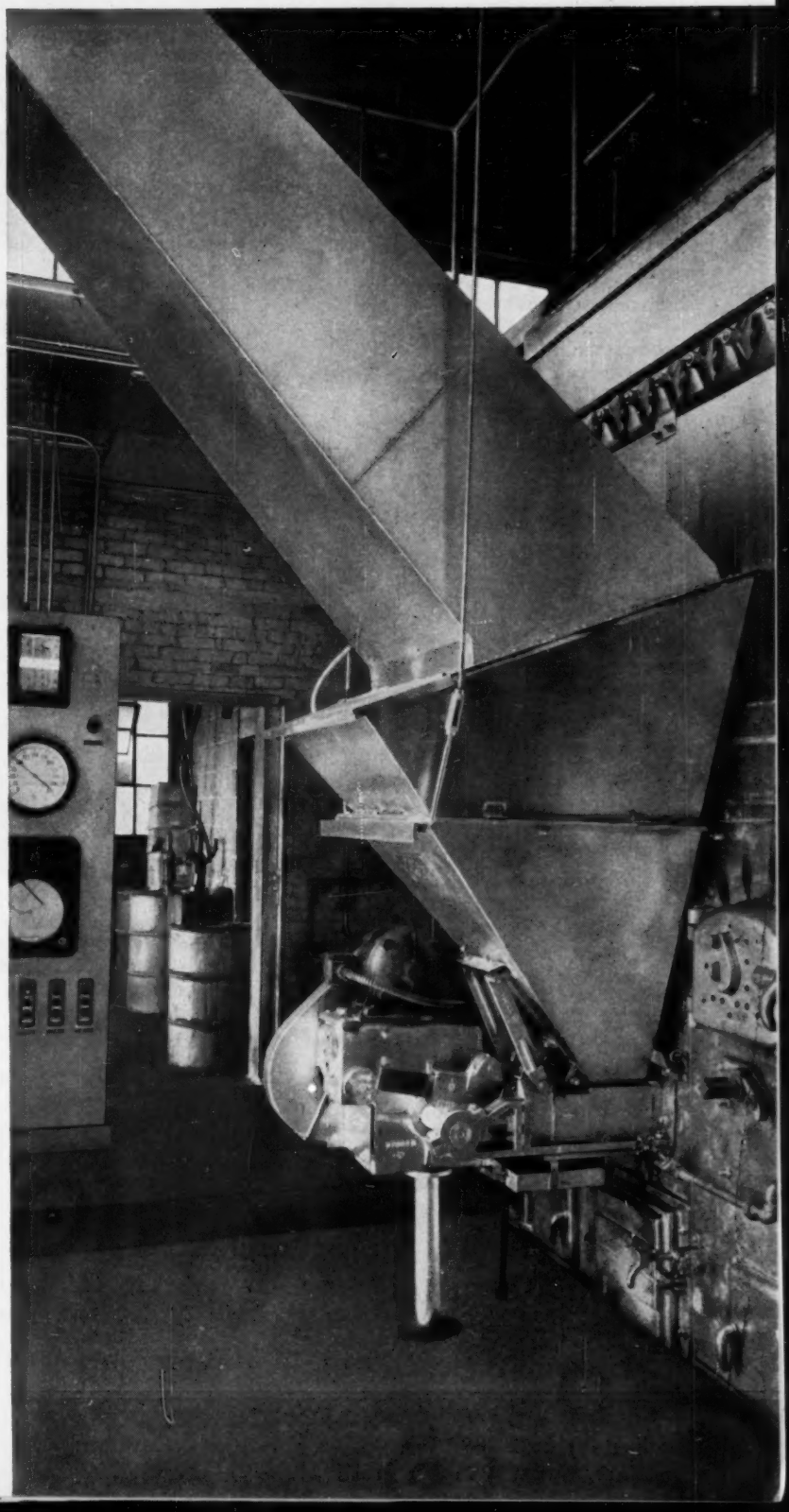
In most industrial areas, bituminous coal is the lowest-cost fuel available • Up-to-date coal burning equipment can give you 10% to 40% more steam per dollar • Automatic coal and ash handling systems can cut your labor cost to a minimum • Coal is the safest fuel to store and use • No smoke or dust problems when coal is burned with modern equipment • Between America's vast coal reserves and mechanized coal production methods, you can count on coal being plentiful and its price remaining stable.

For further information or additional case histories showing how other plants have saved money burning coal, write to the address below.

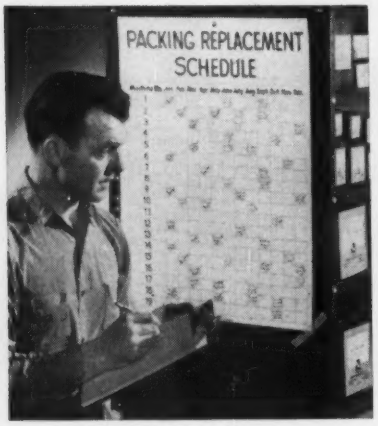
NATIONAL COAL ASSOCIATION
Southern Building, Washington 5, D.C.

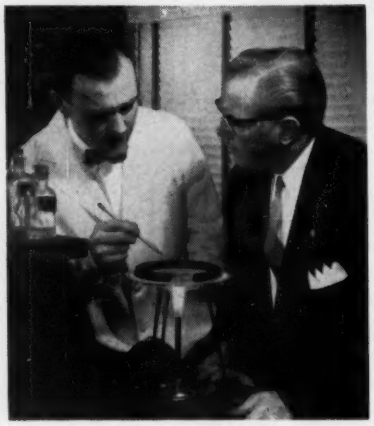


Elevation of Scandinavia's Power Plant



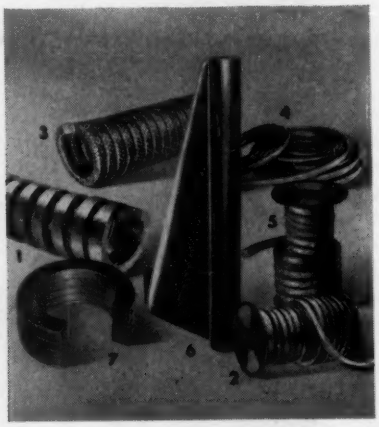
R/M's Big 7 Packing Types will make preventive maintenance easy for you





You can actually set up a schedule of preventive practice with R/M's Big 7 Packing Types. Their custom-built construction will provide you with superlative performance—and lower your maintenance costs and downtime. Most plants find that just 3 or 4 meet all their requirements.

R/M's Big 7 are engineered to give custom-built performance. To assure low friction, for example, the lubricants are ground in during manufacture—not just surface applied. They are locked in so securely that even after wear sets in, the bearing surface remains the same.



See your R/M distributor and find out how easy it is to reduce costs, cut downtime, lower inventories, and simplify ordering by standardizing on the basic, custom-built R/M Big 7 line. All R/M packings for maintenance purposes are sold only through authorized R/M distributors.

Type 1, for pumps, valves; **Type 2,** for high temperature valve stems, expansion joints; **Type 3,** for high speed rotary air compressors; **Type 4,** for corrosives, acids, viscous materials; **Type 5,** "Teflon"* for chemicals; **Type 6,** gasket materials; **Type 7,** for hydraulic and pneumatic equipment.

*Du Pont trademark

R/M's BIG 7 PACKING TYPES MEET 95% OF ALL PACKING NEEDS

R/M **BIG 7 PACKINGS**
RAYBESTOS-MANHATTAN, INC.
PACKING DIVISION, PASSAIC, N. J.

FACTORIES: Bridgeport, Conn.; Manheim, Pa.; No. Charleston, S.C.; Passaic, N.J.; Crawfordsville, Ind.; Peterborough, Ontario, Canada.

RAYBESTOS-MANHATTAN, INC., Packings • Asbestos Textiles • Industrial Rubber, Engineered Plastic, and Sintered Metal Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings • Brake Blocks • Clutch Facings • Laundry Pads and Covers • Bowling Balls.

REPORTS from the FIELD

Begins on page 154

along major product lines. The new divisions will be the Kewanee Boiler division, Kewanee, Ill., which will manufacture Kewanee boilers, and the Ross Heat Exchanger division, Buffalo, N. Y., which will produce Ross heat exchangers, surface condensers and other allied products.

W B Russell is president of the Kewanee Boiler division, with E M Palmer as executive vice-president. Named president and executive vice-president of the Ross Heat Exchanger division, respectively, are John C Linsenmeyer and Richard S Reade. Linsenmeyer will also continue to serve as president of American Blower Corp, another division of American-Standard.

Work progresses on fluid coker at Tide Water Refinery

► ONCE IT GOES into operation, Tide Water Associated Oil Co's new Delaware Flying A Refinery, under construction 15 miles south of Wilmington, will be a reasonable facsimile of a perpetual motion machine.

Not only will it run 24 hrs a day, but the fuel to operate the massive plant will be manufactured on the spot as part of the refining process. The fuel will be refinery gas and coke. The latter will be produced as a plant by-product by a *fluid-coking* process.

Most important function of the coking unit is that it will upgrade refinery fuel oil into the more valuable components of gasoline and heating oils. The by-product from which the process takes its name is a clean, dust-free granulated coke that is industrially and commercially useful.

The coker, now under construction, will have a capacity of 42,000 barrels per day. It will consist chiefly of a large air blower and two tall steel towers —the larger rising to a height of 250 ft. Major portion of the coke will be used to fire boilers at the power stations adjacent to the refinery. The remainder may be sold or burned in other heaters at the plant.

Flue gases from the coking unit, which ordinarily would be sent up the stack, will be burned along with supplementary fuel to generate steam for various refinery uses.

Huge water-treatment plant built for Monsanto Chemical

► A FULLY AUTOMATIC demineralization plant, largest single unit of its kind ever made, has been designed and built by the Belco Division of Bogue Electric Manufacturing Co for the Monsanto

America has homework to do!

THERE'S PROBABLY a lot about your town that makes you want to brag a bit about it.

But there's one thing you *can't* be proud of. And it's a shame you share with just about every other community in America.

The homes where far too many people live are a disgrace. Slums, semi-slums, housing blight are with you. Fixing them up is the homework to be done.

If your town is like most in the U. S., here's what the figures show: 1 out of every 10 homes are rock-bottom slums. Nearly one-half urgently need basic repairs.

But slums are something that is happening on the other side of town, you may say. The problem isn't mine.

Slums are YOUR homework

Distance is no barrier against the threat and cost of housing blight.

Your taxes go up because it takes more money for your town to fight the diseases and delinquency and poverty spawned in the slums. The security of your family goes down because the slum is the natural parent of crime.

Where your business comes in

Every firm has a responsibility toward the town where it's located. Part of it is to support community improvements as any other good citizen would.

Some slums are beyond repair. They must be torn down and a fresh start made. Others can be made to conform to accepted living standards. So it is up to you to get behind every sound program which seeks to provide adequate housing for all our people.

Civic and individual groups must have business backing . . . *your* firm's backing if they are to succeed.

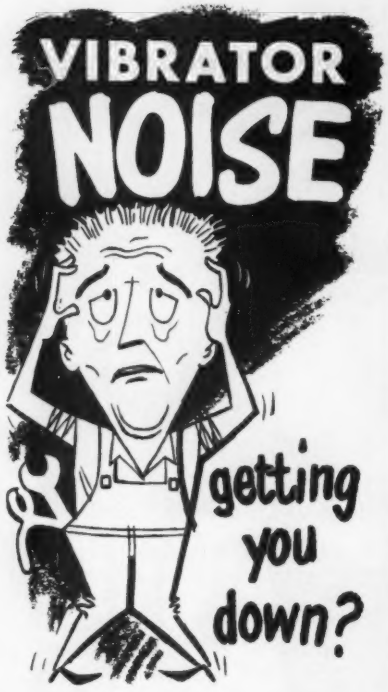
Follow the course of Action!

A group of Americans from every walk of life has joined together in a non-profit organization to combat home and community deterioration, A.C.T.I.O.N., the American Council To Improve Our Neighborhoods.

Send today for a free copy of "ACTION." It explains what A.C.T.I.O.N. is and proposes to do. It lists booklets, research, check-lists, and other material which can help you. Address P. O. Box 500, Radio City Station, New York 20, N. Y.

ACTION

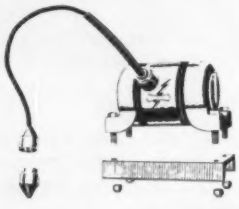
American Council To Improve Our Neighborhoods



The racket caused by conventional electric vibrators can drive a man out of his mind. So why torture yourself and your employees . . . solve the problem with the new silent Cleveland Electric Vibrators?

These new vibrators operate on the eccentric-weight principle—they make no more noise than an electric motor.

For detailed information, write for our new Electric Vibrator Catalog.



Pneumatic and electric vibrators for your every need.

2824 Clinton Ave. • Cleveland 13, Ohio

REPORTS from the FIELD

Begins on page 154

Chemical Co plant at Texas City, Texas.

The system will supply the equivalent of triple-distilled water to the boilers at Monsanto's power plant at a rate of one-half million lb per hr.

The control panel, standing 7 ft 9 in. high and running 33 ft in length, is the largest such graphic panel board in the world. Designed for accessibility and easy inspection by the operator, the panel shows at a glance the flow pattern in any portion of the demineralization plant by means of the lighted "flow diagram" made up of flat plastic strips, each colored for a particular type of flow.

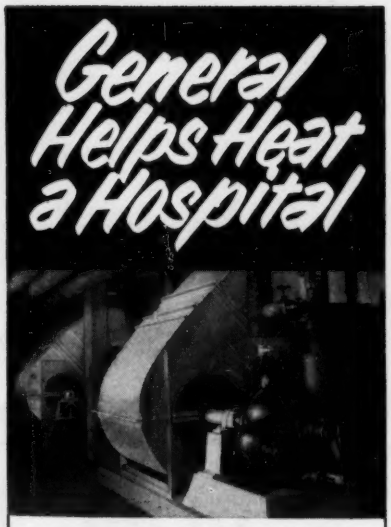
Report explains how water spray acts to extinguish fires. In tests applying experimental water sprays of known size extinguishment occurred if droplet size was within certain limits and total water reaching the test fire exceeded a minimum volume in relation to the drop size. Results suggest optimum average diameter of water droplets is about 300 microns (0.012 in.).

For a copy of "The mechanism of extinguishment of fire by finely divided water," contact Research Division, National Board of Fire Underwriters, 85 John St, New York 38, New York.

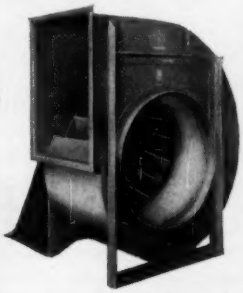
"Portable Parade" is title of sound movie film, in full color, produced by The Oster Manufacturing Co, Cleveland, Ohio and offered on a free-loan basis. It deals with proper selection and use of portable pipe-threading machines, both in shop and out on the job. Running time is twenty minutes.

John Fritz Medal, given annually for distinguished scientific or individual achievement, was presented to Philip Sporn, president of American Gas and Electric Co. Ceremonies were held in conjunction with the 75th Diamond Jubilee Annual Meeting of the American Society of Mechanical Engineers.

"Possibly we could keep this plant going if we had auxiliaries for our auxiliaries."



Letchworth Village State Hospital N. Y. State Dept. of Public Works project. Heating Contractor: The Interboro Co., N. Y. C.

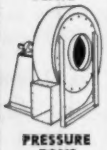


CLASS II construction backward blade centrifugal fan

Shown above is a typical General Blower forced draft installation. The wheel is backward blade, non-overloading, quiet in operation with Spun inlet and wheel cone. General induced and forced draft blowers are skillfully engineered and guaranteed to give long and satisfactory service. Capacities of 200 CFM to 100,000 CFM are handled by standard sizes and arrangements.

TURBOS

STEEL PLATE



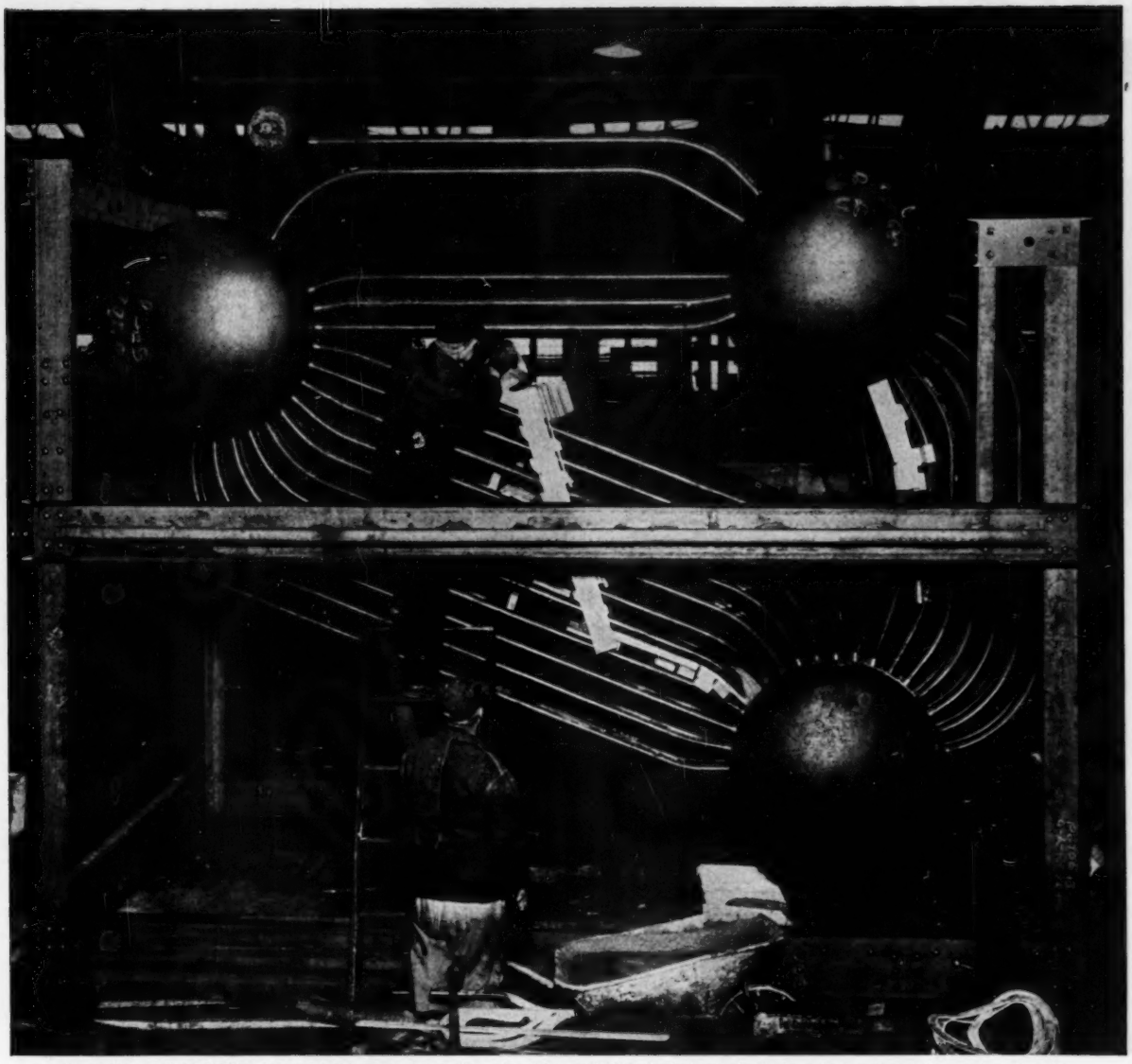
PRESSURE FANS
General Blowers Are Custom Engineered

GENERAL BLOWERS FOR EVERY PURPOSE

• Backward blade centrifugal fans • Forward curve centrifugal fans • Util-A-Vent sets • Roof ventilators—Axial flow fans • Propeller fans • Fume exhausters • Turbo pressure blowers • Gas boosters • Steel plate type industrial fans

AMERICA BREATHES EASIER
"Lungs for Industry"

GENERAL BLOWER COMPANY
8603 FERRIS AVE., MORTON GROVE, ILL.



Monolithic, gas-tight baffles of refractory concrete are easily made with a castable refractory and simple form. Packaged castables used on this job were made by Mexico Refractories Company, Mexico, Mo.

CASTABLES: Fast, Reliable, and Easy to Use

Here's a quick, easy way to handle power-plant refractory installation and repair jobs. Just add water to a prepared castable containing Lumnite* cement, mix, and you're ready to place refractory or insulating concrete. Ideal for lining steel stacks, breechings, boiler walls, doors, coal bunkers, and ash pits. Saves time and cuts costs because concretes made with Lumnite reach service strength within 24 hours.

Castables are packaged mixes of Lumnite calcium-aluminate cement plus aggregates selected for specific temperature and insulation needs. Because they are pre-mixed and ready to use, castables minimize chances for error. They are made and distributed by leading manufacturers of refractories. Keep a supply in your plant at all times. Especially handy for emergencies.

You'll find many uses for industrial concretes made with Lumnite cement throughout your plant. Write today for more information on where and how to use them.

UNIVERSAL ATLAS CEMENT COMPANY

UNITED STATES STEEL (USS) CORPORATION SUBSIDIARY

100 PARK AVENUE, NEW YORK 17, N. Y.

Albany • Birmingham • Boston • Chicago • Dayton • Kansas City • Milwaukee Minneapolis • New York • Philadelphia • Pittsburgh • St. Louis • Waco

* "LUMNITE" is the registered trade-mark of the calcium-aluminate cement manufactured by Universal Atlas Cement Company.

P-L-115

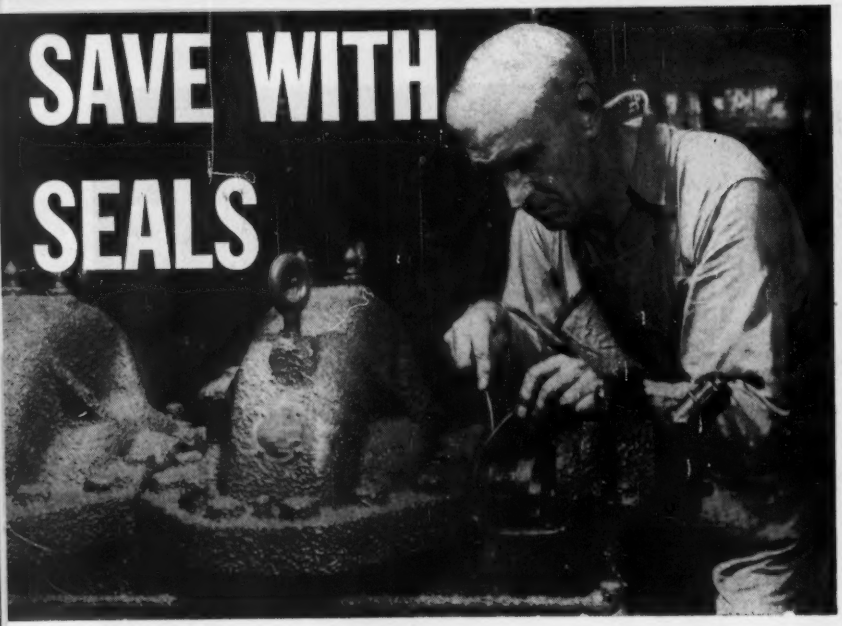
Atlas® Lumnite Cement

FOR INDUSTRIAL CONCRETES

REFRACTORY • INSULATING • OVERNIGHT • CORROSION-RESISTANT

UNITED STATES STEEL HOUR—Televised on alternate Wednesdays—See your local newspaper for time and station

SAVE WITH SEALS



American industry loses billions yearly in leakage and costly equipment downtime resulting from faulty seals—gaskets, packing, piston rings, mechanical seals.

You can stop such losses in your plant by knowing how to select and apply sealing devices.

Now, for the first time, the information you need to do this cost-cutting job is available in a single package.

HERE'S HOW:

Separately, these reprints are priced at 60¢ each. For a short time, we will send you all three, in an attractive data file FOR ONLY $1.50. And if you order now, will include a card enabling you to reserve Part 4 at a special prepublication price.

START SAVING TODAY

Order these reprints now—vital, practical, easy-to-use data giving all you need to know about gaskets, piston rings, packing, mechanical seals.

Gaskets. 20 pages of intensely practical material on gaskets. Covers various gasket materials including asbestos, natural and synthetic rubber. Neoprene, Kel-F, phenolic resins and metals. How to lay out, cut and install gaskets.

Mechanical Packing. Don't let any man in your plant tighten a gland nut until he grasps ideas in this report. Here are packing basics and know-how, never before told in print. Sketches, curves and detailed illustrations tell you how a packing seals, how it's applied, how to prevent costly rod and shaft wear.

Piston Rings. 24-page section gives the dope on the cylinder sealing problem in general, describes ring types, tells you where to use them. Passes along tips on installing, operating, renewing rings, plus making them in emergencies.

Mechanical Seals. Coming in 1956. 24 pages of illustrations and text showing and explaining in simple language what mechanical seals are, what jobs they do and how to apply them to your equipment. These seals do not wear your shafts, are now running up to 100,000 rpm, at 500 F without a drop of leakage, in smaller sizes.

ORDER TODAY— OFFER IS LIMITED

POWER
330 W. 42nd St.
New York 36, N.Y.

Please send.....sets of Basic Data on Seals.
I enclose $.....
Include my special bonus card with each set.

NAME_____

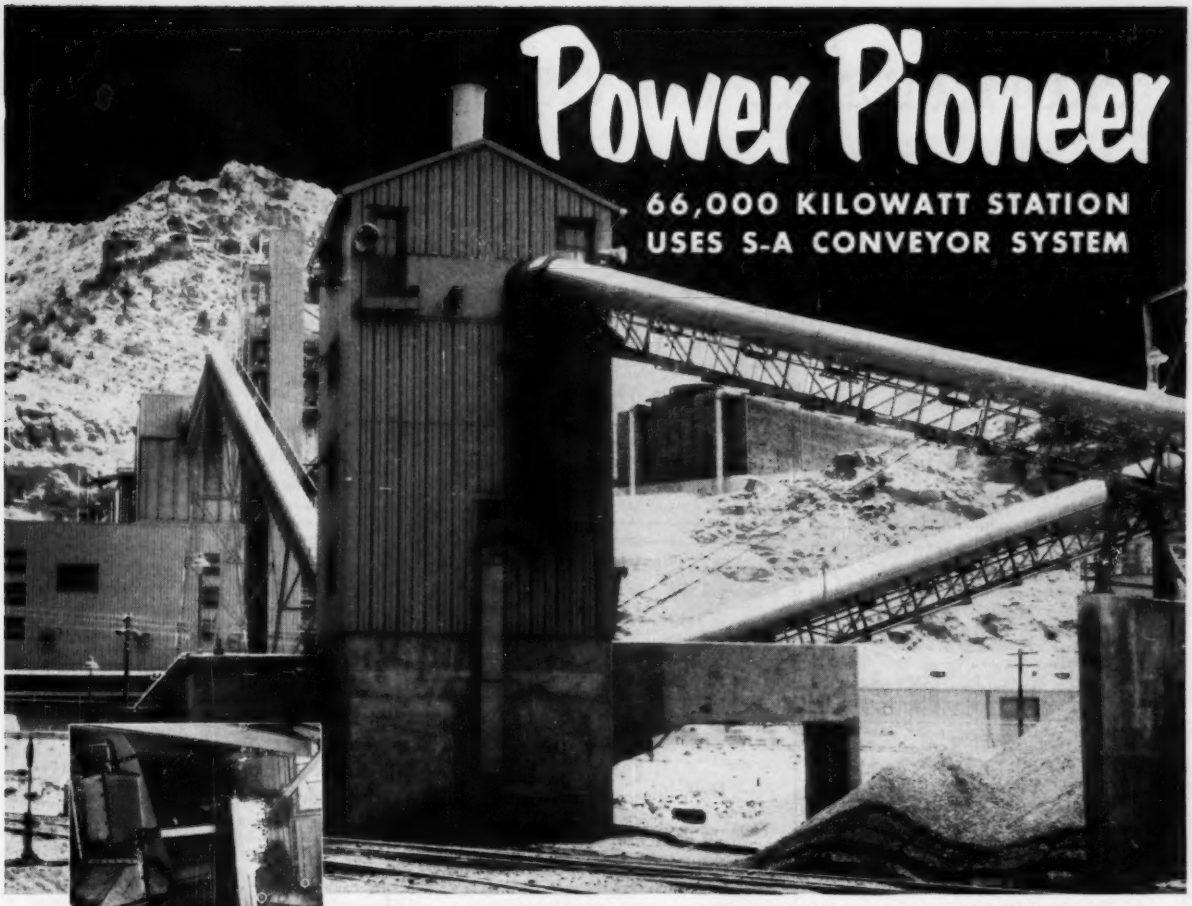
STREET_____

CITY_____ ZONE NO. _____ STATE_____

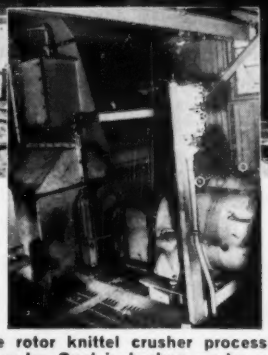
Please reply before February 1, 1956. This coupon void after that date.

Power Pioneer

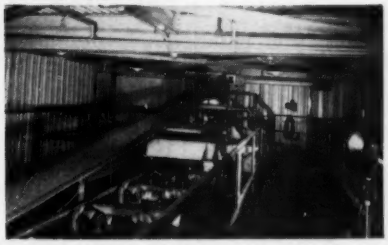
66,000 KILOWATT STATION USES S-A CONVEYOR SYSTEM



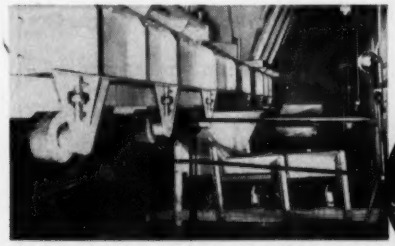
GENERAL VIEW OF CONVEYOR GALLERIES RUNNING TO AND FROM CRUSHER HOUSE



Double rotor knittel crusher processes 200 tons per hr. Coal is broken up by rotating twin sector gangs and dropped through size classifying grate.



Traveling tripper discharges 24 inch conveyor belt at any point into coal bunkers at either side of conveyor. Tripper covers a 55 ft. run.



Coal is discharged from track hoppers by twin S-A reciprocating plate feeders. Coal is moved underground at a rate of 200 tons per hour. Feeders are 40 in. wide by 14 ft. long.

The first steam-electric station to serve advancing power demands in the area, this Utah Power and Light Company plant depends for coal delivery on a conveyor system built and engineered by Stephens-Adamson. Tremendously rich in coal and other mineral deposits, the barren country around Price, Utah is destined to serve one of the nation's future great industrial centers.

As usual, S-A custom designing has been instrumental in effecting initial cost savings. Routine maintenance has been made easy by "in the open" construction.

Coal handling problems get swift and expert treatment by S-A engineers. They are capable of complete plant layout or are available to work in cooperation with your plant engineer.

More than half a century of designing and manufacturing experience is why it will pay you to convey the S-A way. We know how to move bulk materials at lowest possible cost per ton. From our very complete line of manufactured products we can supply the smallest or largest requirements.

SINCE 1901 S-A STEPHENS ADAMSON MFG. CO.

STEPHENS-ADAMSON MFG. CO.

5 Ridgeway Ave., Aurora, Ill.—Los Angeles, Calif.—Belleville, Ontario.

ENGINEERING DIVISION
Designers and manufacturers of all types of bulk materials conveying systems.

STANDARD PRODUCTS DIVISION
A complete line of conveyor accessories—centrifugal loaders—car pullers—bin level controls, etc.

SEALMASTER DIVISION
A full line of industrial ball bearing units available in both standard and special housings.

PROFESSIONAL SERVICES

BLACK & VEATCH

Consulting Engineers

Electricity—Water—Sewage—Industry
Reports, Design, Supervision of Construction,
Investigations, Valuation and Rates

1706 Broadway — Kansas City 12, Missouri

BURNS & McDONNELL

Consulting and Designing Engineers

Kansas City, Mo. — Phone
P. O. Box 7088 — Delmar 4375

GILBERT ASSOCIATES, INC.

Engineers and Consultants

Design and Construction Supervision
Industrial • Sanitary • Chemical Laboratory Services
Business and Economic Research
Industrial Relations • Purchasing

New York — Reading, Pa. — Washington

INTERNATIONAL ENGINEERING COMPANY, INC.

Engineers

Investigations — Reports — Design
Procurement — Field Engineering
Domestic and Foreign

74 New Montgomery St., San Francisco 5, Calif.

THE KULJIAN CORPORATION

Engineers - Constructors - Consultants

POWER PLANT SPECIALISTS
(Steam, Hydro, Diesel)
Utility • Industrial • Chemical

1200 N. Broad St. — Philadelphia 21, Pa.

PETER F. LOFTUS CORPORATION

Design and Consulting Engineers

Electrical • Mechanical • Structural
Civil • Thermodynamic • Architectural

First National Bank Building
Pittsburgh 22, Pennsylvania

THE LUMMUS COMPANY

Engineers and Constructors

385 Madison Ave., New York, N. Y.

Chicago . . Houston . . London
Paris . . The Hague . . Montreal
Caracas . . Bombay

LUTZ AND MAY COMPANY

Consulting Engineers

Steam, Gas & Diesel Power Station
Pumping Plants—Electric Systems
Reports—Design—Appraisals

1009 Baltimore — Kansas City 6, Mo.

PIONEER SERVICE & ENGINEERING CO.

Consulting and Design Engineers
Purchasing
Specialists in
Financing, Accounting & Other Operations

231 So. La Salle St. — Chicago 4

SANDERSON & PORTER

Construction

REPORTS — SURVEYS

New York — New York

SARGENT & LUNDY

Engineers

140 South Dearborn St. — Chicago, Illinois

SEELYE STEVENSON VALUE & KNECHT

Consulting Engineers

Mechanical — Electrical — Civil
Surveys Reports Design

101 Park Avenue — New York 17, N. Y.

J. E. SIRRINE COMPANY

Engineers

Power Plant — Consultations
Design — Reports
Water — Steam Utilization — Plants

Greenville — South Carolina

STANLEY ENGINEERING COMPANY

Consulting Engineers

327 S. La Salle Street — Hershey Building
Chicago 4, Illinois — Muscatine, Iowa

A. L. SWANSON AND COMPANY

Consulting Engineers

Power Plants
Sawmills—Industrial Plant Layout
Heating—Ventilating—Plumbing
Reports, Designs, Drawings, Specifications

2210 West 12th Avenue — Vancouver 9, B. C.

WATER SERVICE LABORATORIES, INC.

Water Treatment for corrosion control in buildings, boilers and air conditioning systems—Chemical Laboratory Services—Consultations.

New York—Philadelphia—Washington, D. C.

THE J. G. WHITE ENGINEERING CORPORATION

Design-Construction-Reports-Appraisals

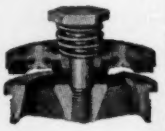
80 Broad Street, New York 4

Reach new clients through this Professional Service Section

WHERE TO BUY

HILL PUMP VALVES

Since 1909



• The valve with the renewable feature restores old pumps to original efficiency. Constant contact is maintained over the full bearing surface no matter in what position the valve rotates because of the exclusive HILL design. Efficient, durable, economical, assurate.

Write for Bulletin

HILL PUMP VALVE CO.
2728 Elston Ave., Chicago 47, Ill.

Master GLASSES

HIGH PRESSURE GASKETS

All sizes to fit your gages
ERNST WATER COLUMN & GAGE CO.
Send for Catalog — LIVINGSTON, N. J.

STEEL PIPE & TUBING

• CHROME MOLY • CAREON MOLY
• MONEL • CAREON STEEL • STAINLESS
• HASTELLOY

Widest Range of Sizes & Specs in the U.S.
WRITE FOR STOCK LIST
Send us your Surplus Lists
MIDCONTINENT TUBE SERVICE, INC.
2308 Oakton St., Evanston, Ill. DA 8-4030

Your inquiry will have Special Value . . .

If you mention this magazine, when writing advertisers. Naturally, the publisher will appreciate it . . . but, more important it will identify you as one of the men the advertiser wants to reach with this message . . . and help to make possible enlarged future service to you as a reader.

DESIGN ENGINEERS

PERMANENT OPPORTUNITIES WITH McKEE

IN OUR REFINERY, METALS OR INDUSTRIAL DIVISIONS AT OUR CLEVELAND, OHIO OFFICES

McKee with more than 50 years of successful operation, doing business all over the world; is one of the largest, oldest and best known engineering and contracting firms in the business. The McKee organization continues to grow and expand, thereby offers many present and future opportunities for qualified and experienced engineers and designers in the following fields:

PIPING • STRUCTURAL STEEL
CONCRETE • PROCESS HEATERS
EQUIPMENT SPECS.
ALSO
Electrical Drafts • Layout Engineers
Process Engineers

Applicants should have at least five years' of experience.

Here is a rare opportunity for you to utilize your engineering abilities and talents.

McKee offers top compensation commensurate with experience and ability. No age limitations.

Transportation & Moving Allowances.

Please Send Resume to: EDWARD A. KOLNER

ARTHUR G. McKEE & CO.
2300 Chester Ave., Cleveland 1, Ohio

EMPLOYMENT OPPORTUNITIES

MOVE AHEAD with DU PONT

challenging, creative
remunerative
CAREER
OPPORTUNITIES
for experienced
GRADUATE ENGINEERS

Make the change now—meet the challenge of the future and your own development with a rewarding du Pont career. An industrial leader for 153 years, du Pont's keyword is continuing growth. Be a pioneer in du Pont's vast and diversified engineering programs of today and tomorrow.

Apply today for immediate openings in the Design Division of du Pont's Engineering Department—one of the largest in the world, presenting opportunities for advancement and development through association with alert, creative minds of the highest calibre in all fields of engineering.

Fill one of the six immediate openings for Power Designer-Engineer. Four require a minimum of four and the other nine years' design experience of industrial plant facilities required to supply utility services to chemical processes. Applicable design experience should be in steam generation and distribution, water supply and treatment, refrigeration, fire protection, outside pipe lines, process waste disposal and industrial furnaces.

Designers selected will design and engineer a variety of the above mentioned facilities as are required by new or existing chemical processes. Work can involve not only economic installations, but also the challenge of meeting special requirements in connection with process problems.

Please send complete resume, including details of education and experience, to:

MR. T. J. DONOVAN
Personnel Relations Section
Engineering Department
E. I. du Pont de Nemours & Co., Inc.
Wilmington 98, Delaware

DU PONT
Better Things for Better Living
...through Chemistry

REPLIES (Box No.): Address to office nearest you
CHICAGO: 520 N. Michigan Ave. (11)
NEW YORK: 330 W. 42 St. (36)
SAN FRANCISCO: 68 Post St. (4)

POSITIONS VACANT

Want to live in sunny Tucson? Results engineer, assistant, or man in similar capacity, familiar with all phases of power plant operation, for technical studies and sales engineering with large established manufacturer of water treating equipment. Work in famous health and recreation area; ideal dry Southwestern climate. Write care Box P-7762, Power.

Position Vacant Power plant superintendent for a municipal steam electric generation plant. Present average load 3200 KW. Plant in good condition. Must understand full operation and be able to direct personnel. Apply to Carl W. Fuehrer, Borough Manager, Ephrata, Pa. giving qualifications, salary expected, availability for interview and date position could be accepted.

Engineer have fine opportunity for a young graduate engineer in a high pressure industrial power plant. Experience preferred though not required. Write stating education, experience, salary requirement, and recent snapshot if available. Location Texas Gulf Coast. P-8289, Power.

Wanted—Chemist. New England public utility has openina for experienced power plant chemist, preferably college graduate under 36. Send resume of education and experience with statement of salary requirements to: P-8662, Power.

Engineer to supervise high pressure and process piping job. Experienced in layout, ordering of pipe, fittings, valves, etc. State experience, references and salary desired. Project starting February 1st—5 months to complete. Job location Jacksonville, Florida. P-8663, Power.

POSITIONS VACANT

Sales Position with opportunity for future advancement. Manufacturer of small high pressure steam turbines wants a young engineer capable of handling national sales and of eventually becoming sales manager. Experience in turbine or allied sales desirable. Send complete resume of education and experience to P-8462, Power.

EMPLOYMENT SERVICE

Salaried Personnel, $5,000-$30,000. This confidential service established 1927 is geared to needs of high grade men who seek a change of connection under conditions assuring, if employed, full protection to present position. Send name and address only for details. Personal consultation invited. Jira Thayer Jennings, Dept. G, P.O. Box 674, Manchester, Vermont.

POSITIONS WANTED

Power Engineer, age 31, technical education 12 years experience licensed chief engineer, complete resume on request. PW-8270, Power.

Senior Electrical Engineer, married no family, age 45. Technical education, 15 years experience in electrical distribution of Public Power Supply Company in Europe. During this period ten years night school teaching experience. 10 years experience with oil companies: a) in South American Refinery and b) in Far Eastern Oilfields. Generation and distribution. Planning and administrative experience and ability. Speaks Spanish, French and German. Desires position as Chief Engineer, assistant to management, etc. Available for personal interview as from 1st March 1956. PW-8274, Power.

(Continued on following page)

ENGINEER

Aircraft Nuclear Power Plant Design

For Advanced Design Group of the Aircraft Nuclear Propulsion Department:

The next step in the application of nuclear power —aircraft propulsion—offers both professional challenge and opportunities for personal achievement at General Electric.

A responsible position is now open for an engineer interested in this field; must have an engineering degree, several years diversified experience in analysis and design of power plant components, including design of nuclear reactors. The job carries the responsibility for preliminary design analysis of power plants, and directing completed scale design and layout drawings of power plants and equipment.

Publication of Research Results in the Appropriate Classified or Open Literature is encouraged.

Openings in Cincinnati, O. and Idaho Falls, Ida

Write to

Mr. W. J. Kelley
General Electric Co.
P.O. Box 132
Cincinnati, Ohio

Mr. L. A. Munther
General Electric Co.
P.O. Box 535
Idaho Falls, Idaho

Aircraft Nuclear Propulsion Dept.

GENERAL ELECTRIC

POWER PLANT PERSONNEL

A middle east coast utility now constructing a new high pressure, pulverized fuel generating station will accept applicatcns for employment from qualified persons for the following positions, which are available immediately.

Results or Test Engineer

Must be graduate mechanical engineer or equivalent, with experience in modern power plant operation and three years in a responsible supervisory results position. Will be required to assume full charge of power plant testing, chemical control, accounting and research.

Power Plant Electrical Foreman

Excellent job for a man who has had extensive experience in handling a group of electricians in the maintenance of all electrical equipment in large power plants or substations. Must be able to organize and schedule work and be thoroughly competent to direct trouble shooting on complicated control systems and relaying.

Power Plant Chemist

To assume full charge of modern laboratory. Must be experienced and thoroughly conversant with the analysis of water, fuel and lubricating oils. Must know water softening and conditioning in a large water treating plant, and be able to interpret test results into instructions to operators for correction of unusual conditions.

Assistant Results or Test Engineer

Graduate mechanical engineer or equivalent, with experience in power plant test and technical work. Will conduct tests and research and maintain records under direction of the Results Engineer.

Job is located near excellent residential community, good working conditions, forty hour week (paid vacations, insurance, sick pay and retirement plan).

High caliber men are needed to fill the foregoing jobs, and for applicants meeting the above requirements, consideration will be given to reimbursement of expenses incurred for the moving of household goods and personal effects.

All personnel selected will receive training at full pay in order to familiarize themselves with the plant before assuming their duties. Include a complete resume of experience and qualifications in first letter. All applications will be treated confidentially.

P-8299, POWER
330 W. 42 St., New York 36, N. Y.

ASSISTANT STEAM AND POWER SUPERINTENDENT

Challenging opportunity for an Assistant Superintendent in the Steam and Power Plant of a chemical company in the Detroit area. Responsibilities include operation and maintenance of Boiler House, Engine Room, and supervision of over 100 employees. Applicants must have college degree and supervisory experience in Steam and Power work.

Excellent benefits, good living conditions. Position offers growth and opportunity to man with ability and initiative. Please submit complete resume, including salary requirements in first letter.

P-8503, POWER
330 W. 42nd St., New York 36, N. Y.

POSITIONS WANTED
(Continued from preceding page)

Power Plant Supt. three years, medium press. 15,000 KW steam station. Technical education. Twelve years in mechanical, electrical and refrigeration field. Three years in the erection of mechanical equipment. Desires position with future, where honest and good results will be rewarded. Present salary $500 mo. Age 34, married and family, money is not the reason for desiring a change. PW-8643, Power.

Engineer with supervision experience, presently employed in medium size power plant. Desires position as chief engr. or equivalent in an industrial plant. Over 10 years in mechanical and power engineering. Licensed Chief Engr. of A.S.M.E. City. Married young man with family, prefer Southern location. PW-8648, Power.

SELLING OPPORTUNITIES WANTED

Heavy industrial boiler plant equipment account for New York Metropolitan area or Northern N. J. to complement present line of boiler feedwater treating equipment. Foster Equipment Co., 145 Sussex Rd., W. Englewood, N. J.

Manufacturers' Representative covering largest power and industrial firms in territory desires equipment lines for Eastern Pennsylvania, Delaware and Southern New Jersey. RA-8601, Power.

Personnel Managers—Need experienced Engineers and Technicians? We offer a booklet especially prepared to help you solve this problem. Write for your "free" copy of "Reservoir of Engineers and Technical Men." Searchlight Dept., Power, 330 W. 42 St., New York 36, N.Y.

SEARCHLIGHT SECTION

(Classified Advertising)

BUSINESS OPPORTUNITIES — EQUIPMENT - USED or RESALE

WANTED

2—625 KVA 2300/3/60 Diesel Engine generator sets—Fairbanks Morse 720 RPM, 6 cylinder type 38D, 8½" much referred because of repair parts now on hand.

500 KW, 4000 amp, 125 volt Dc generator, 514 RPM or repair parts (including commutator) for Canadian General Electric type MPC, class 10, number 24222.

1—Double Drum Electric Hoist—5' minimum diameter—both drums clutched—4000 lbs—1000 ft FPM —2400 ft. 1" cable with 3/60/440 or 550 or 2300 volt motor and complete control.

1—200-300 KVA steam engine generator set 2300/3/60 with or without boilers with stokers—175 pounds—to exhaust against 15 pounds.

4—50 amp, 2300 volt, 3 pole double throw switches —oil type preferred would consider open disconnecting type but must be double throw.

3—1600 KVA 60/1 transformers or 1—5000 KVA three phase, 13,800 to 2400 volts.

3—333 KVA 60/1 transformers or 1—1000 KVA 3 phase 13,800 to 550 volts pyranol or non-oil type preferred for installing in basement.

Please send your surplus lists—We have been selling Electric and Power equipment here 45 years. We have surprised many important customers by producing precious machines for immediate shipment when they said it could not be done.

SOUL CLINIC INC.
Calgary, Alberta, Canada

LEFAX TECHNICAL DATA BOOKS

POCKET SIZE • LOOSE LEAF

Loose leaf, 6 hole, 6¾"x3¾" bond paper, each book approx. 140 pages of technical data for student, engineer, technical worker. **$1.25 ea.**

Architecture	General Math	Phys. & Thermo. Data
Home Heating	Math Tables	Metals
Illumination	Physics	Metallurgy
Electrician's Data	Trig.-Log Tables	Hydraulics
Builder's Data	Gen'l Chemistry	Radio
Lumber Data	Chemical Tables	Television & FM
Air Conditioning	Analytic Chem.	Electricity, AC
Building Constr.	Mech'l Drawing	Electricity, DC
Reinf. Concrete	Machine Design	AC Motors & Gen'trs.
Piping Data	Machinist's Data	Transformers.
Surveying	Mech. of Materials	Relays & Meters
Surveying Tables	Pwr. Trans. Mach.	
Highway Eng'g.	Thermo. Tbls.	

Write for FREE catalogs (2000 listings). Send $1.25 book or $6 for any five books to
LEFAX PUBLISHERS, Dept. PO-1, Phila. 7, Pa.

Prepare for
REFRIGERATION LICENSE

More than 300 multiple choice questions from past exams. Many sketches. 96 pages 8½" x 11". Send $3 to:

W. D. TURNER
44 West 63rd St., New York 23, New York

WANTED

Ca. 1600 HP Diesel Engine. Fairbanks-Morse or GM preferred.

W-8561, POWER
330 W. 42 St., New York 36, N. Y.

LIDGERWOOD HOIST

Serial #8001. 250 H.P. 2300 volt slip ring motor drive Hoist designed for 350 f.p.m. of 1⅞" rope. Face of drum 55-9/16", diameter to bottom of groves, 84" Electric brake connected. Split drum, all steel base, Blue prints available.

2000 KVA G.E. type H. T. Form D.H. 66,000/22000/2300/60 cycle. Serial #4540898.

ELJAY INC.
L. J. LAND, Pres.
401 Broadway, New York 13, N.Y.
Telephone WOrth 6-0969

WANTED

Steam Engine Generator Sets • Turbines • Condensers • Generators • Boilers • or Complete Power plants.

PAUL OBERMAN
1910 Delmar St. Louis, Mo.

DIESEL UNITS

1250 KVA and 375 KVA—General Motors
438 KVA (2) Diesels, also 3—187 KVA
250 KVA & 187 KVA Chicago Pneumatic
62 KVA (2) International; mobile.

TURBO UNITS

1250 KVA Elliott, non. con.-bleeder, 325#-145# bleeder; & 5# bp
250 KVA Murray, 400#; 30/110# exhaust.
250 KVA Murray 100/150#; 0/15# bp
937, 625 & 125 KVA, General Electric

BOILERS:
250 to 1000 HP, mostly B&W

POWER PLANT EQUIPMENT CO., Inc.
234 Willets Ave., West Hempstead, N. Y.

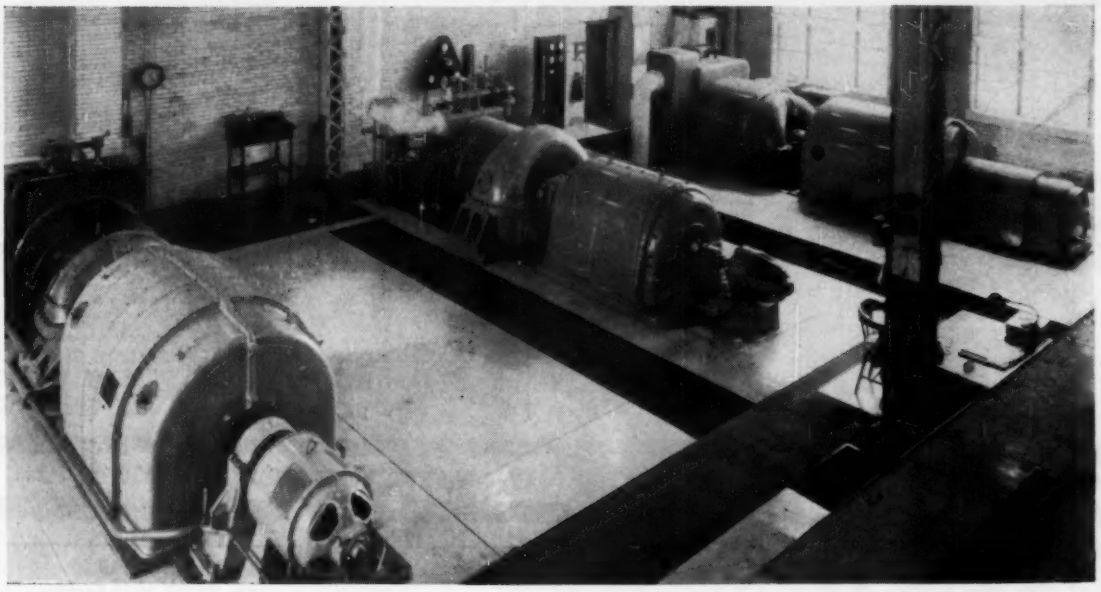
Westinghouse Metal Clad Switch Gear

5 units—manual oil breakers, 600 amps, 15,000 volts, 3 phase, 50,000 KVA interrupting capacity, in good condition. Can be seen in place at present —must move soon.

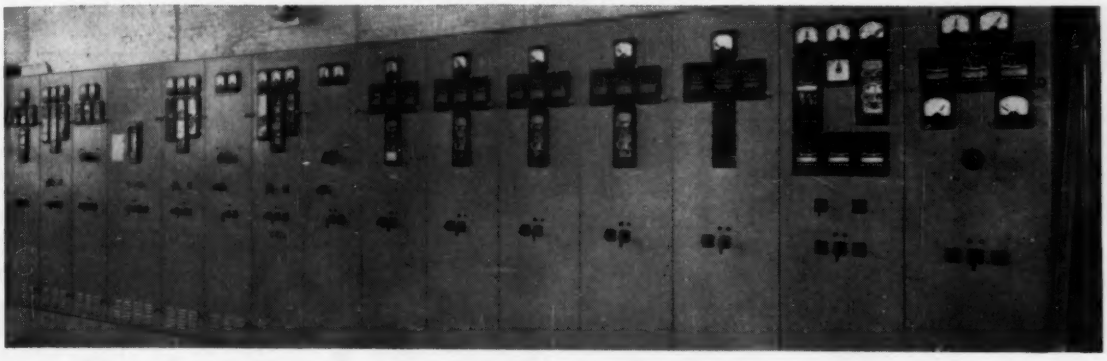
WOODSTOCK, ILLINOIS, POWER AND LIGHT
BOX 190, WOODSTOCK, ILLINOIS

If there is anything you want
that other readers can supply
OR . . . something you don't want—
that other readers can use—
Advertise it in the
SEARCHLIGHT SECTION

3750 KVA, 2500 KVA, Westinghouse & 1563 KVA G. E. Turbine-Generators



Above Turbine-Generators are all 400# PSIG, 750 Degrees FTT 3/60/2300 V., equipped with 2-pass Surface Condensers, direct-connected Exciters, complete with all parts and fittings. Serial Number of Westinghouse Turbine, 3750 KVA, is #5-A-3107-1, new 1949. Other units rebuilt and pressures changed to 400# PSIG in 1948. All units are in good operating condition; just came out of service 30 days ago and are still on foundations.



ABOVE IS THE SWITCHBOARD SERVING THESE UNITS

We own above equipment outright. Will sell it complete, as shown, or will sell each unit separately.

PHONE
WRITE
OR WIRE

CHARLES WEAVER
19701 JAMES COUZENS HIGHWAY
DETROIT 35, MICHIGAN

TELEPHONE:
BROADWAY
3-1901

CHICAGO *Electric Co.*

. . . the right combination of facilities, service and skill to solve your industrial power problems.

We Carry Complete Stocks of

GUARANTEED "REBUILT" EQUIPMENT

WRITE FOR CURRENT STOCK LIST OR PHONE CANAL 6-2900

MOTOR GENERATOR SETS

KW	MAKE	A.C.	D.C.
1000	G.E.	13,200	600
500	Westg.	2300	250
400	Al-Ch.	2300	120/240
400	G.E.	2300	270
300	Westgh.	2300	250
200	G.E.	2300	250/275
200	Westg.	4160/2200	275
200	Ridgeway	2300	250
170	G.E.	440	125
150	Al-Ch.	2300	275

D. C. MOTORS

*230 Volt

HP	MAKE	TYPE	SPD.
250	Westg.	SK-220	450/600
200	Westg.	SK-201	650
200	Cr-Wh.	CM	500
175	G.E.	ELC	750
100	G.E.	MPC	400/800
100	G.E.	RC-34	2500
100	G.E.	RC-19	575
50/120	G.E.	MCF	250/1000
50	G.E.	DLC204	650
50	Cr-Wh.	CMC	700/1100

SLIP RING MOTORS

3 phase, 60 cycle, 220 or 440 volts (*2300 volts or higher)

HP	MAKE	TYPE	SPEED
2000	*G.E.	MT	600
1500	*G.E.	MT-80	240
1250	Westg.	CW	600
1200	*Al.-Ch.	ANV	1800
1000	*Westg.	CW	450
700	*Al-Ch.	ANV	720
500	Westg.	CW	350
500	Westgh.	CW	600
400	G.E.	IE-17	900
400	Al-Ch.	3 brg	450
300	*G.E.	IE-15A	1200
250	*G.E.	I 17H	450
200	G.E.	IK 15B	900
200	G.E.	IM-17	600

SQUIRREL CAGE MOTORS

3 phase 60 cycle, 220 or 440 volts (*2300 volts or higher)

HP	MAKE	TYPE	SPEED
1250	*Al-Ch.	ANW	3600
1250	*Al-Ch.	ANW	1200
800	*Westg.	CS	3600
800	*Westg.	CS-1485	1800
700	*Westg.	CS	1200
700	Al-Ch.	AN	900
500	*Al Ch.	6316-8W	1800
500	G.E.	KT-424	450
500	*G.E.	KT5698	900
350	G.E.	KT-424	360
350	Ideal	A	1800
300	*G.E.	K-6341Y	1200
300	G.E.	K-6353 TEFC	720
250	*L. Allis	OGK-148	720
250	*G.E.	IK	600
250	G.E.	IK 17A	900

SYNCHRONOUS MOTORS

3 phase, 60 cycle, 220 or 440 volts (*2300 volts or higher)

HP	MAKE	TYPE	PF	SPD
1420	*West.		.7	900
800	G.E.	TS-EL	1.	1200
700	G.E.	TS-EL	.8	1200
600	*G.E.	TS-7640	1.	900
500	*G.E.	TS-7657	1.	514
400	West	HC	1.	900
300	G.E.	ATI	.8	720
300	*Ideal	SMAI	.8	257
250	Al.-Ch.		1.	1200
250	G.E.	ATI	.8	900

SPECIALS!!!

PLATING GENERATOR SETS

AMPS	D.C.	MAKE	A.C.
7500/3750	6/12	Elec. Pdts.	220/440
2000/1000	6/12	Chandy	220
1500/750	6/12	Chandy	220

SPEED REDUCERS

HP	MAKE	MAX SPEED	TYPE & RATIO
250	W.A. Jones	1200	210 SH; 5.63:1
150	W.A. Jones	1200	180 SH; 5.63:1
30	Falk	1750	3026E; 9.394:1

CAPACITORS

22—15 KVAR Cornell Dubilier, type DB-11, 460 v./3 Ph./60 Cy. Indoor dust-tite, fireproof, non-explosive capacitors, complete with indiv. fuses & discharge resistors.

FREQUENCY CHANGERS

KW	MAKE	FREQ	VOLTS
50	G.E.	60/120	440/440
20	Al.-Ch.	60/180	440/330
20	Westgh.	60/120	440/440

CHICAGO *Electric Co.* 1320 WEST CERMAK RD, CHICAGO 8, ILL.

---

3 G. M. 200 KW DIESEL GENERATOR SETS

Reconditioned by U.S. Navy

EQUAL TO NEW

Complete with motor driven starting air compressors, air tanks, dead front type generator switch panels and all other necessary accessories.

ENGINES

G.M. Model 8-268A—6½x7—1200 RPM—air starting—complete with engine operating panels, heat exchangers, cooling pumps, filters, strainers, governors, pyrometers, etc.

GENERATORS

Westinghouse 200 KW 250 KVA—440/3/60—1200 RPM—80% P.F.—continuous—drip-proof enclosure—direct connected exciter.

SIZE AND WEIGHT

Each unit, mounted on a pre-fab sub-base, is 13' 9 5/16" long, 3' 10½" wide, approx. 8' high. Weight of engine and generator only 17,705 lbs. Each unit, with all accessories, about 27,000 lbs.

CONDITION

No expense has been spared to put these 3 units in "equal to new" condition. Don't miss this opportunity to buy! Inspection can be made at our warehouse, Curtis Bay, Baltimore.

THE BOSTON METALS CO.
313 E. BALTIMORE STREET
BALTIMORE 2, MD CURTIS 7-5050

PUMPS

2—24"x24" Dayton Dowd Centrifugal, 18,000 GPM, at 35' Hd.
1—5"x10" McGowan Hydraulic, 185 GPM, 500 PSI, #30005
1—3½"x10" Worthington Hydraulic, Type D1654, 85 GPM, 500 PSI, #978859

TRANSFORMERS

100—1½ KVA, Line Material, Dry type, 120/240/480 volt primary 120/240 volt secondary with taps, 1 phase, 60 cycle
3—150 KVA, Moloney, OISC, 4000 volt primary, 230/460 volt secondary, 1 phase, 60 cycle.
3—250 KVA, General Electric, OISC, 2300 volt primary, 460/230/115 volt secondary, 1 phase, 60 cycle.
6—500 KVA, Westinghouse, OISC, 2300 volt primary, 460/230 volt secondary, 1 phase, 60 cycle.

GASOLINE POWER UNITS

6—53 HP, NEW, Chrysler Industrial, Model 7A-458, base mounted, complete with controls including four-speed transmission.

BENSON-WILIMZIG, INC.
1704 North 8th St. St. Louis 6, Mo.
Phone GArfield 1-4290

---

150 HP, 150# Packaged Type Boiler—1950
500' Sections of 42" Wide Belt Conveyors
30 HP good for 200# Pressure E. City Boiler
8000 CFM—400 PSI Air Compressor; Like New
250 HP, 150# Pressure HRT Boilers; Good
300 KW, 250 V. Dir. Current Eng.—Gen. Set
312 & 121 KVA F-M Diesel Electric Plants
175 HP "VL" Erie City, 160# P. Boiler
H. & P., 6719 Etzel, St. Louis 14, Mo.

FOR SALE
18 NEW TURBINES

4 horizontal, 14 vertical, Westinghouse

Driving forced draft blowers—capacities ranging from 39000 to 56000 CFM and 16" to 24" pressure. Steam pressures 360 to 575#, back pressure 10#.

Will sell turbines separately if desired. *Price reasonable.*

Also—1—250 KW GE turbo generator unit, 3 phase, 60 cycle, 440 volt. Used one year.

G. M. DeROSE
2457 WOODWARD AVE.
408 DONOVAN BLDG.
DETROIT 1, MICH.

LAND

EST. 1910

ELECTRICAL EQUIPMENT

A.C. & D.C.

MOTORS AND GENERATORS

One of America's Largest Stocks

RELIABLY REBUILT IN OUR OWN SHOP

1 YEAR GUARANTEE

Send us your inquiries

L. J. LAND INC.

148 GRAND ST., NEW YORK 13, N. Y.
Phone: CAnal 6-6976

—TRANSFORMERS—

BOUGHT AND SOLD

We carry a large stock of rebuilt and guaranteed transformers, and invite your inquiries.

Custom-built transformers and coils manufactured to your specifications.

Expert Repair Service—all makes and sizes of transformers rewound, repaired and redesigned. Ask for our price schedule.

THE ELECTRIC SERVICE CO., INC.
5318 Hetzel St. Cincinnati 27, Ohio

40 Years' Dependable Service

FOR SALE

One-Rice and Sargent Engine-Generator Set, in Excellent Condition, consisting of:
1—150 KW—125 V DC Generator
1—225 HP—150 RPM—120# Sat. Steam Corliss Horizontal Engine

Write or Phone:

Power Division
THE ANDREW JERGENS COMPANY
2535 Spring Grove Ave., Cincinnati 14, Ohio

BELYEA RE-NU-BILT
LARGE ELEC. POWER EQUIPMENT
SELECTED STOCK ITEMS

RE-NU-BUILT—GUARANTEED—RE-NU-BILT
COMBINATION MILL DRIVES — 15/2500 HP
D.C. MOTORS WITH M.G. SETS & CONTROLS

	MAKE	TYPE	VOLTS	R.P.M.
2200 HP	G.E.	MCF-12	600	400/500
2000 KW	G.E.	Syn.	2300/4000	514
1400 HP	G.E.	MCF14	600	63/190
1500 KW	G.E.	Syn.	6600/13200	720
1250 HP	Whse.	Rev.	600	360/600
1000 KW	G.E.	Syn.	2300/4600	720
1250 HP	G.E.	MCF	600	750/900
1000 KW	G.E.	Syn.	2300/4600	720
1000 HP	G.E.	MCF-8	600	350/700
1000 KW	G.E.	Syn.	2300/4160	720
350 HP	Whse.	Mill	250	325/650
300 KW	Whse.	Syn.	220/440	1200
200 HP	G.E.	CD-1650Z	250	500/1500
200 KW	Whs.	Syn.	440	1200

ALSO MANY OTHER COMBINATIONS

A. C. MOTORS—3Ph. 60 Cy.

SLIP RING

Qu.	H.P.	Make	Type	Volts	Speed
1	1500	G.E.	MT-498	2300	360
1	1000	A.C.	Mill	2300	240
1	750	G.E.	MT-573	2200	1190
1	700	Al. Ch.	D.P.	2300	500
1	500	Whse.	CW	550	350
1	500	G.E.	M-569Z	2200	1180
1	400	Whse.	CW-960A	440	1170
1	400	Whse.	CW	440	514
1	400	Whse.	CW-1218	2200	435
1	350	G.E.	IM-17A	440/2200	720
1	350	G.E.	MT-442Y	2200/4000	253

SQUIRREL CAGE

1	800	G.E.	KT-573	2200	1180
2	650	G.E.	FT-559BY	440	3570
1	500	G.E.	K-6345S	2300	1185
2	450	Whse.	CS-1120	2300/4150	354
1	400	G.E.	1E-15B	2300	1165
1	400	G.E.	IK	2200	580
1	200	G.E.	IK-17	440	580
3	200	G.E.	KT-557	440	1800
1	150	Whse.	CS	440	580

SYNCHRONOUS

1	4350	C.W.	3501-8L	13800/6900	514
2	1750	G.E.	ATI	2300	3600
2	2000	Whse.		2300	120
2	735	G.E.	ATI	2300/12000	600
1	500	Ideal	SM	2300/4160	1800
2	500	G.E.	TS-7567	2200	1200
1	450	Whse.		2200	450
1	400	G.E.	TS	2200	400

M-G SETS—3 PH. 60 CY.

Qu.	K.W.	Make	RPM	DC Volts	AC Volts
2	2000/2400	G.E.	450	250/300	2300/4600
1	2000	G.E.	500 25cg	600	11000
2	2000	G.E.	514	600	6600/13200
1	1750/2100	G.E.	514	250/300	4800/2400
1	1500	G.E.	720	600	6600/13200
1	1000	G.E.	720	600	2300/4600
1	1000	G.E.	900	260	6600
1	750	Whse.	900	250	2300/4150
1	750	G.E.	900	125/250	2200
1	600	G.E.	720	250	440/2300
1	300	Whse.	1200	250	440/2300
1	250	A.C.	900	125	2300/4000
1	200	Whse.	1200	250	220/440
1	150	Whse.	1200	600	2200

SIX 1200 KW RECTIFIERS

Whse., D.C. output, 2000 Amp., 283/600 volts, with 1328 KVA, 3 ph., 60 cy., Transf., 11,000 volts and controls. Can furnish for other voltages.

TRANSFORMERS

Qu.	KVA	Make	Type	Ph.	Voltages
1	3000	Wagner	HPW-20	3	26400x2400
1	1000	Pitts.	OISC	3	26400/13200x2400
3	550	Kuhl.	OISC	1	2300x230/460
3	333	G.E.	HS-WB	1	2300/4600x230/460
3	333	G.E.	HD	1	13200x2530x4350Y
3	250	Penn.	OISC	1	34500x120/240

FREQUENCY CHANGER SETS

Qu.	KW	Make	Freq.	Voltages
1	12500	Whse.	60/25	13200/13200
1	5000	G.E.	60/50/60	6600/11000/6600
2	2500	G.E.	25/62.5	2300/2300
1	1000	G.E.	25/58.3	4400/2300
1	500	Al. Ch.	2560	11000/2300

TURBO GENERATORS

Qu.	KW	Make	Desc.
1	4000	G.E.	Condensing 425 — 750 F.T.T. Surface Condenser 3/60/2300/4000 V Direct conn exciter.
1	1500	Whse.	Auto. extraction 190 lbs.—600° F.T.T. 60 lb. extraction 3/60/240 V. Div. conn. Exc.
1	1000	Moore	Auto-Ext. Cond. 175/200# I.S.P. 5/20# G. Ext. Surface Condenser—3/60/2300.
1	1000	G.E.	Non-condensing 175/200 lbs. I.S.P. 5/20 lbs. G.B.P., 480/3/60.

BELYEA COMPANY, INC.
43 Howell St., Jersey City 6, N. J.

1906 — OUR 50th YEAR — 1956

"Certified Rebuilt" Motors and Generators

D. C. MOTORS

HP	Mfr.	Type	Volts	Speed
300	Allis Ch. b.b.	EW	250	1000
200	Allis Ch. b.b.	EW	250	650
150	Whse.	SK-201	230	300/900
150	Whse.	SK-184	230	850
100	Whse.	SK-173	230	850
100	Reliance	651T	550	1000/1600
100	Reliance	651-T	230	575/1150
75	Whse.	SK-180	230	475/900
75	Cr. Wh. TEFC	53H	230	850
75	F. Morse b.b.	DH-140	115	1600
50	G.E. dynam. (4)	TLC25	250	1000/3500
40	Whse. (2)	SK-133	230	850
35	Gen. Elec.	RF-14	230	250/1000
30	Imperial b.b.	D69	230	400/1600
30	Star b.b. (3)	SB	230	1750
25	L. A. TEFC	RNA	230	850

200 KW M-G SET—LIKE NEW
Whse. DC 250 V. gen. w/synch. motor, 3/60/220/440 V., incl. AC & DC control. Quick shipment, low cost, guaranteed.

MOTOR-GENERATOR SETS

KW	Mfr.	Input V	Output V.
500	Gen. Elec.*	2560/4000 AC	600 DC
200	El. Machy.*	220/440 AC	250 DC
200	Whse.*	220/440 AC	55 DC
200	Gen. Elec.*	220/440 AC	125 DC
200	Whse.*	220/440 AC	250 DC
150	Gen. Elec.	220/440 AC	125 DC
150	Whse.	2200/440 AC	275 DC
125	Gen. Elec.*	2300/4000 AC	250 DC
105	Century b.b	220/440 AC	70 DC
100	G.E.*	2200/440 AC	125 DC
100	Whse.	220/440 AC	250 DC
75	F. Morse b.b.	220/440 AC	125/250 DC
75	Whse.	2200/440 AC	600 DC
60	Gen. Elec.*	220/440 AC	60 DC
50	Gen. Elec.	220/440 AC	125 DC
50	Whse.	220/440 AC	250 DC
40	Whse. (2)	220/440 AC	250 DC
30	Gen. Elec. (2)	220/440 AC	125 DC
30	F. Morse b.b.	220/440 AC	24 DC
30	Allis Ch.	220/440 AC	250 DC
25	Whse.	220/440 AC	125 DC
20	Rel. b.b. (2)	220/440 AC	250 DC

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
250	Allis Ch. b.b.	EW	250	1200
175	Allis Ch. b.b.	EW	250	900
150	Whse. b.b.	SK-163L	250	1800
150	Whse.	SK-184	250	1150
105	Century b.b.	1500 amp.	70	1200
100	Whse.	SK-173	250	1150
100	Allis Ch.	E	125	1200
100	Reliance	651T	600	1200
75	F.M. b.b.	DG	125/250	1200
75	F.M. b.b.	DG	125	1800
75	Cr. Wh. bb (2)	CCD	250	1150
75	Whse. b.b.	SK-163	125	1000
50	Whse.	SK-150	250	1000
40	Whse.	SK-133	250	1150
25	G.E. b.b. (10)	CD85	250	2300
25	Whse.	SK93	125	1750

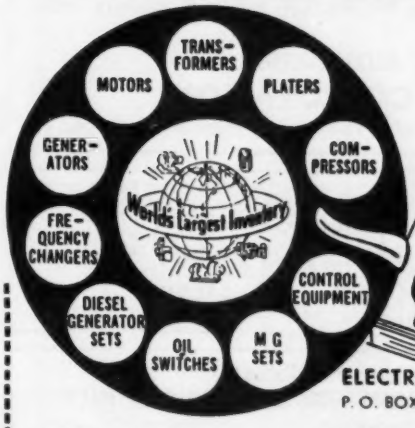
A. C. MOTORS — 60 CYCLE

HP	Mfr.	Type	Volts	Speed
700	G.E.	Synch.	2200	514
700	Allis Ch.	Sq. Cage	440	900
700	G.E.	Synch.	2200/440	1200
600	G.E.	Slipring	2300	600
600	G.E.	Synch.	2200	327
500	G.E.	Sq. Cage	2200	3600
500	G.E.	Sq. Cage	4000	1800
450	Allis Ch.	Synch.	480	400
400	G.E.	Slipring	2200	900
400	Whse.	Sq. Cage	2200	514
400	G.E.	Synch.	440	450
300	Gen. Elec.	Slipring	220/440	1200
300	El. Machy	Synch.	220/440	360
300	Al. Ch.	Sq. Cage	2200/440	720
300	G.E.	Slipring	440	360
250	Gen. Elec	Sq. Cage	440	3600
250	Whse. X-P	Sq. Cage	2200	3600
250	Burke	Synch.	220/440	360
250	G.E.	Slipring	220/440	720
250	G.E.	Sq. Cage	220/440	900
250	Gen. Elec.	Synch.	220/440	450
250	G.E.	Synch.	220/440	720
250	L.A. (2)	Sq. Cage	2200	1800
225	G.E.	Synch.	220/440	900
200	Whse. (2)	Slipring	2200/440	720
200	Gen. Elec.	Sq. Cage	220/440	1200
200	Reliance b.b.	Sq. Cage	220/440	1800
200	Allis Ch.	Slipring	440	450
200	Gen. Elec.	Sq. Cage	2200/440	720
200	Cr. Wh.	Sq. Cage	220/440	3600
200	Whse.	Sq. Cage	2300/4400	900
200	E. M.	Synch.	220/440	1200
175	G.E. (2)	Synch.	220/440	720
150	El. Machy.	Synch.	220/440	360
150	Allis Ch. (2)	Slipring	220/440	1200
150	Allis Ch.	Slipring	2200/440	720
150	G.E. (2)	Sq. Cage	2200/440	720
150	Rel. b.b.	Sq. Cage	220/440	1800
150	Allis Ch.	Sq. Cage	440	450
150	G.E. vertical	Slipring	4000/2300	1200
125	Gen. Elec.	Slipring	440	600
125	G.E.	Slipring	220/440	720
125	G.E. TEFC	Sq. Cage	220/440	3600
125	Whse.	Sq. Cage	220/440	900
125	Rel. TEFC	Sq. Cage	220/440	1800
125	G.E.	Slipring	220/440	450
125	Allis Ch.	Slipring	220/440	900
100	G.E.	Slipring	220/440	720
100	G.E.	Slipring	220/440	514

A. C. GENERATORS — 60 CYCLE

KVA	Mfr.	Type	Volts	Speed
1000	Whse. syn cond		4000/2300	900
700	Gen. Elec.	ATI	2300/480	1200
625	Gen. Elec.	ATB	2300	450
485	Allis Ch.	1 brg.	480	400
275	G. E. 25 cycle	ATI	480	750
225	El. Machy.		480	720
225	Gen. Elec.	ATI	240/480	900
156	Whse.	C	240/480	1200
150	Whse.		2300/480	600
75	El. Machy.		2300	900
56	G.E.	ATB	240/480	1200
37½	Whse.		240/480	1200

ARTHUR WAGNER COMPANY
1435 W. RANDOLPH ST.
CHICAGO 7, ILLINOIS
TELEPHONE MONROE 6-7409



Phone Station Collect
Glenwood 6783

ELECTRIC EQUIPMENT CO.
P. O. BOX 51 • ROCHESTER 1, N. Y.

NEW AND GUARANTEED REBUILT
•
BOUGHT SOLD RENTED

JAN. SPECIAL—F.O.B. Detroit • **4—1500 KW Motor Generator Sets**
2—Westinghouse • 2—Gen. Elec. • 250 V. D.C. 13,800-4160-2400V A.C., Syn.

Rebuilt HEMPHILL Guaranteed EQUIPMENT

TRANSFORMERS 60 CYCLE

Qu	KVA	Make	Type	PH.	Voltages
1	750	G.E.	HT	3	4150x120/240
2	750	G.E.	H	1	4600x120/240
2	400	Pitts.	OISC	1	4150x240/480
2	333	West.	S	1	4150-240/480
2	300	G.E.	H	1	13200-110/220
3	50	G.E.	H	1	2400/4800-120/240
1	25	G.E.	Pyranol	1	2400/4160-120/240
3	200	G.E.	H	1	7800/15600-440/220
3	150	Amer.	OISC	1	2400/4160-240/480

SYNCHRONOUS MOTORS

QU	HP	Make	Speed	Type	Volts
1	1400	G.E.	514	ATI	4150
1	1000	Whse.	225	Mill	2300/4150
1	1000	West.	260	Mill	2300/4150
1	500	Whse.	450	HR	2300
1	300	EM	720	TEFC	2300
1	300	G.E.	600	ATI	220/440/2400
1	200	Whse.	600	ATI	240
1	150	G.E.	1800	TS	220
2	150	Allis	360		2200
1	125	G.E.	600	TS	2200
1	125	EM	900		4800
1	100	G.E.	900	TS	2200

SLIP RING MOTORS

QU	HP	Make	Speed	Type	Volts
1	500	G.E.	1200	M	2400-1150
1	400	Whse.	450	CW	450
1	250	Whse.	600	CW	440
1	200	Whse.	600	CW	440
3	150	A.C.	1800	AY RW	2300
1	100	G.E.	1800	IM	220
1	75	G.E.	600	IM	440
1	60	G.E.	1800	MT	220
1	200	Whse	500	CW	440

SQUIRREL CAGE 60 CYCLE

Qu.	HP	Make	Type	Speed	Volts
1	200	West.	C.S. Exp Proof	1800	220/440
2	250	G.E.	K.F. TEFC	1800	2300
1	150	G.E.	KT-502	600	440
1	100	West.	CS	1200	440

MOTOR GENERATOR SETS

Qu	KW	Make	Speed	DC	AC
1	1000	G. E.	514	600	2300/4150 Syn
1	1000	Whse.	720	600	2300/4150 Syn
1	1000	Whse.	720	275	2300/4150 Syn
1	300	G.E.	1200	250	2300/4150 SR
1	150	C.W.	600	125	220/440 V
1	97	G.E.	1200	80	4150 Syn
1	75	G.E.	1800	250	220/440 SC
1	60	Whse.	1200	60	2200V
3	60	EM	1200	125	220
1	30	Whse.SK	1750	250	2300/4150 Syn
1	20	EM	1800	125	220 V
2	30	G.E.	1800	125	220/440 V

DC, 230 VOLT MOTORS

Qu	HP	Make	Speed	Type
2	150	C.W.	900	WP
1	125	G.E.	1700	RC
2	75	C.W.	900	WP
3	30	C.W.	700	CM
1	35	G.E.	850	RC
1	25	Whse.	835	MC
1	30	G.E.	1650/1800	CDM85

"FOR POWER"
J.L. HEMPHILL & CO.
1603 54th STREET, NORTH BERGEN, N. J.
PHONE NEW YORK—LONGACRE 5-3227
PHONE NEW JERSEY—UNION 3-2600

3 NEW VERTICAL CIRCULATING PUMPS

STEAM TURBINE DRIVEN

Manufactured by Warren Steam Pump Co.—26,500 GPM at 13.5 lbs. and 840 RPM. Test pressure 50 lbs.—submergence 72" water—suction lift 8" Hg. Westinghouse turbine—steam pressure 575 lbs. G.—Superheat O F—exhaust pressure 15 lb. G—HP 300—RPM 4150—Type 20-V-R-G-B—steam chest pressure 900 lbs.—serial No. Pump 23706-23708-23707—Turbines 5A1034-51-50-44.

COCHRANE DEAERATOR

Maximum pressure 20 lbs.—220,000 lbs. per hour—1800 gallons storage volume.

THE BOSTON METALS CO.
313 E. BALTIMORE STREET
BALTIMORE 2, MD. Curtis 7-5050

3000 KW MODERN Westinghouse Turbine-Generator COMPLETE

NEW 1949: Installed 1950: Very High Grade Unit
Steam 400# psig., 750° FTT, 3/60/2300-V.
Surface Condenser, All Auxiliaries, Switchboard

Send for Complete Data

CHARLES WEAVER
19701 James Couzens Highway, Detroit 35, Mich. • Tel. BR. 3-1901

FOR SALE

6—100 KVA 60 cy. 1 ph. O.I.S.C. Transformers 2400-120/240.
6—75 KVA 60 cy. 1 ph. O.I.S.C. Transformers 2400-120/240.
9—37½ KVA 60 cy. 1 ph. O.I.S.C. Transformers 2400-120/240.
19—15 KVA 60 cy. 1 ph. Dry Type 240/480—120/240.
15—25 KVA 60 cy. 1 ph. Dry Type 240/480—120/240
8—37½ KVA 60 cy. 1 ph. Dry Type 240/480—120/240.
3—50 KVA 60 cy. 1 ph. Dry Type 240/480—120/240.
3—10 KVA 60 cy. 3 ph. Dry Type 480—208Y/120.
2—37½ KVA 60 cy. 3 ph. Dry Type 480—208Y/120.

ATLANTIC TRANSFORMER CO.
5143 N. 2nd St., Phila. 20, Pa.
Phone: Michigan 4-6963

3000 KW MODERN POWER PLANT—COMPLETE

NEW 1949 ***LITTLE USED***

3000 KW Turbo generator, Allis Chalmers 3600 RPM 3/60/2300/4600 Volts 400# 600° FTT cond. 28" Vac.
50000 lbs/hr Boiler, Union Iron Works, 450 psi incl. stokers with traveling grates

WITH ALL AUXILIARIES

HUGO NEU CORPORATION
31 Nassau St. Tel: REctor 2-1334 New York 5, N. Y.

MODERN EQUIPMENT

For Chemical Plants, Steam and Electric Use and General Industrial Applications.

TURBO-GENERATORS—up to 15,000 KW Condensing Extraction and Non-Condensing type up to 900# P.S.I.G. Boilers—New and second-hand. 900# P.S.I.G. Package Boilers, 100 HP and up. Diesel Engines and Generator Sets. SPECIALS: 2 new 35000# Boilers, 425 p.s.i.g.; 3—50,000# per. hr. 400# p.s.i.g.; 5—40,000# hour, 230 p.s.i.g. Vertical Steel Sectional header. B&W.

1—4000 KW—400# condensing, 125# automatic extraction Turbo-generator.

HOWE BROTHERS
342 Madison Ave., New York 17, N.Y.
Tel: MUrryhill 2-8562

1250 KVA FAIRBANKS MORSE DIESEL UNIT

1—1250 KVA Crocker Wheeler generator, 3 phase, 60 cycle, 2300/4000 volts, 720 RPM direct connected to 1600 HP Fairbanks Morse diesel engine, model 38D8—1/8, 720 RPM.
Installed 1950. Excellent condition.

INTERNATIONAL POWER MACHINERY CO.
1610 Union Commerce Bldg., Cleveland 14, Ohio

90 HP CYCLOTHERM STEAM GENERATOR
1—125 lb. Pres. Boiler Oil Fired Located Ohio
MODERN DIESEL GENERATORS
1—1200 KW Chgo. Pneu. 2400 V.
4—1000 KW Gen. Motors 2400/4160 V.
1—520 KW 1—480 KW Superior 2400 V.
1—300 KW Gen. Motors 2400 V.

DARIEN
60 E. 42nd St., New York 17, N. Y.

2—TURBO GENERATOR UNITS

Westinghouse turbine, Max. press. throttle 340# P.S.I.G., Bleeder Station 110# P.S.I.G., Exh. 30# P.S.I.G Satu. Steam. Ser. Nos.—12750 & 12751.

W.H. AC gens., 1563 K.V.A., 480 volts, 1880 amps., 60 cyc., 3600 R.P.M., type SO-2G135, 80% P.F., 3 ph., Ser. No.—4953392-93.

W.H. DC exc., type SK, 16 K.W., 125 volts, 128 amps., 3600 R.P.M., frame 43, sty. No. 2G136.

Still on fndn. In exc. condition. Price and further inf. on request.

PHILADELPHIA TRANSFORMER CO.
Box 566 Dalton, Pa. Ph.: 3-4811

New and Used Equipment Available for
POWER PLANTS, SUBSTATIONS, TRANSMISSION LINES AND CONSTRUCTION
Send for new list
EBASCO SERVICES INCORPORATED
APPPARATUS EXCHANGE Two Rector St., New York 6, N. Y.

SPECIALS

3—2160 KW BUSCH-SULZER DIESEL GENERATOR SETS, 3/60/4160/2300, complete. New 1942. Can be seen operating.

1—1500 KW MG Set, 250 volts DC, 2300/4600/3/60.

1—200 KW MG Set, 250 volts DC, 2300/3/60.

1—200/245 HP, 250 volts MILL MOTOR, 600/700 RPM.

1—6000 GPM DEEP WELL PUMP, 80' head.

4—300 HP KEWANEE BOILERS, 125 PSI. NEW 1942.

2—150 HP UNION WATER TUBE BOILERS, 160 PSI.

1—250 HP STIRLING BOILER, 150 PSI.

3—4' x 135' STEEL STACKS, welded.

PHONE—WIRE—WRITE

HEAT & POWER CO., INC.

60 East 42nd St., New York 17, N.Y.

Murray Hill 7-5280

(Machinery & Equipment Merchants)

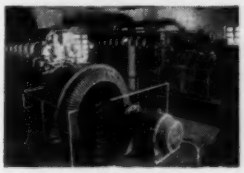
DIESEL ELECTRIC POWER

STATIONARY PORTABLE MOBILE

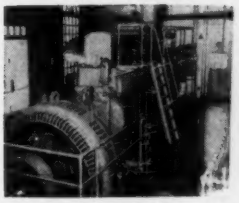
100 KW TO 1500 KW

ENGINEERED DIESEL POWER

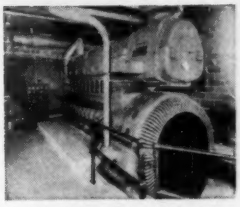
A.C. AND D.C. ALL SIZES



Cleveland Cliffs Iron Works



Hawaiian Pineapple Company



Municipal Power Plant
Herkimer, N. Y.

SPECIALISTS IN DESIGN FOR YOUR REQUIREMENTS

WRITE FOR BROCHURE

A. G. SCHOONMAKER CO., INC.

Box 516, Sausalito, Calif. • 50 Church St., New York 7, N. Y.

COMPRESSOR DIRECTORY

World's Best Rebuilts

All Makes
Many Sizes

Electric
Steam
Gas
Diesel

AIR

for Sale or Rent
Air
Since
1902

1 CFM to 5700 CFM
1 lb. to 3500 lbs.

American
AIR COMPRESSOR CORP.
DELL AVE. & 47th ST.
NORTH BERGEN, N.J.
Telephone UNion 5-4848

1—2500 KVA—GE Curtiss Turbo Generator 3-60-2300V—3600 RPM, 18-B-2 4 stage turbine condenser

1—18" Worthington Cent. Pump LCS-2—2 stage—270' head, 12140 GPM, 1000 HP G.E. Syn. motor, 3-60-2300V

1—20" Worthington Cent. Pump, 12140 GPM—49' head

HARRIS MACHINERY COMPANY
501 30th Avenue S. E., Mpls., Minn.

HYDRO-ELECTRIC GENERATING UNITS

2—UNITS—250 KW—600 VOLT—20 FT. HD.
1—UNIT—500 KW—2300 VOLT—28 FT. HD.
1—UNIT—500 KW—2300 VOLT—36 FT. HD.

All units good condition complete with switchgear can be delivered loaded in R.R. cars at $25.00 per KW or less. For complete information.

SORENSON GOVERNOR SERVICE
264 KOSSUTH ST., BRIDGEPORT, CONN.

37 Years Dependable Service

SLIP RING MOTORS 3-Ph., 60 Cy.

H.P.	Volts	Make	Speed
500	2200	G.E.	450
450	440	Whse.	514
400	4000/2300	Whse.	450
400(2)	2300	G.E.	900
300	2200/440	G.E.	720
300	440	G.E. (hoist)	600
300	2200	G.E.	360
300	440	Whse.	3600
250	2200/440	G.E.	1200
250	440/220	Whse.	600
250	550/440	G.E.	1200
225	4000/2300	G.E. (hoist)	600
200	440/220	Whse.	514
150(2)	440/220	G.E.	720
150	2200/440	G.E.	600
125	550/440	G.E.	1200
125	2200	G.E.	600

SYNCHRONOUS MOTORS 3-Ph 60 Cy.

H.P.	Volts	Make	Type	R.P.M.
400	2200/440	G.E.	ATI	720
375	2200	Whse.	G	900
350	440/220	El. Machy.	Syn.	1200
300	2300/400	G.E.	TS	720
300	2200/440	G.E.	TS	1200
250	2200/440	G.E.	TS	720
250	440/220	Whse.	HR	277
250	440/220	G.E.	ATI	600
125	440/220	Whse.	HR	400

SQUIRREL CAGE MOTORS

H.P.	Volts	Make	Type	Speed
600	2200	G.E.	FT	3600
500	2200/4000	Elliot	SC	1800
400	2300/4000	Whse.	CS	720
400	2300/4000	G.E.	K	1800
350	440	G.E.	KT	1200
300	2300/4000	L. Allis	FS	1800
250	2300	Whse.	CS	600
250	2300	G.E.	K	900
225(2)	2200/440	G.E.	KT	1200
200	440/220	G.E.	KT	1800
200	2200/440	G.E.	JK	600
200	2200	G.E.	KT	1800
150	2200	Al. Chal.	AR	1800
150	220	Whse.	CS	1200
150	440/220	G.E.	KT	720
150	2200/440		KT	600

A. C. GENERATORS

1—320 kva, 660 rpm 2300/440/220 V., G.E.
1—300 kva, 900 rpm, 2200 V., Whse.
1—225 kva 60 rpm, 220/440 V., G.E.
1—200 kva, 720 rpm 2200/440 V., G.E. (Ball)
1—187 kva, 1200 rpm, 2200/440 V., Whse.

CIRCUIT BREAKERS

2—2000 amp. GG E., 3 pole, 600 V.
2—1600 amp. ITE, 3 pole, 600 V.
6—FKR-155-28, 600 amp., 15,000 V. G.E.
1—400 Amp., Condit, 3P, 25 KV outdoor
1—400 Amp., R. Smith, 3P, 7.5 KV outdoor

D. C. MOTORS

H.P.	Volts	Make	Type	Speed
225	230	Whse.	SK	2870
150	230	El. Dyn.	B/brg.	800
150	230	Whse.	SK	1750

MOTOR GENERATOR SETS

	Input V.,		Motor	Output V.,
KW	Make	AC	Type	DC
250	Whse.	2200	Syn.	250
200	G.E.	440/220	Syn.	250
175	G.E.	220/440	Syn.	230
125	G.E.	4000/440	Syn.	125
125	G.E.	440/220	Syn.	250/125
100	Al. Ch.	220/440	Sq. Ca.	240/120
65	G.E.	2200/440	Sq. Ca.	230

TRANSFORMERS 60 Cy.

1—1000 kva, Whse., 13,800—2300 V., 3 ph., New
1—600 kva, Standard, 13,800—2300 V., 3 ph.
1—500 kva, Whse., 66000—2300 V.
3—333 kva, G.E., 23000/11500—2300 V.
3—333 kva, Mol., 13,800—2300 V.
3—333 kva, G.E., 2400—480 V.
2—300 kva, G.E., 4150—240 V., 3 ph., Pyr.
3—200 kva, Mol., 13,800—2300 V.
3—200 kva, G.E., 2300—575 V.
3—100 kva, Al. Ch., 2400—480/240 V.

only partial listing

STEPHEN HALL & CO.

HARRY J. RICE, Pres.

625 ADAMS ST., HOBOKEN 2, N. J.

ADVERTISERS' INDEX

This index is a service to readers. Every effort is made to maintain its accuracy, but POWER cannot assume responsibility for errors or omissions. When a star appears after the name, the advertisement does not appear in this issue but appeared in an issue within the previous three months.

Air Preheater Corp. 51
Alco Products, Inc. ..... *
Allen-Sherman-Hoff Co. ..... Second Cover
Allis-Chalmers Mfg. Co. 32, 52, 56
Allpax Company, Inc. 236
American Blower Corp. 14-15
American Engineering Co. 217
American Gilsonite Co. ..... *
American Pulverizer Co. 245
Ames Iron Works, Inc. ..... *
Anchor Packing Co. 67
Arkansas Fuel Oil Co. 179
Armstrong Cork Company 43
Armstrong Machine Works 145

Babbitt Steam Specialty Co. ..... *
Babcock & Wilcox Co. 6-7, 193
Babcock & Wilcox Co. (Refractories Div.) 54
Babcock & Wilcox Co. (Tubular Products Div.) ..... *
Badger Mfg. Co. ..... *
Bailey Meter Co. 12-13
Baldwin-Hill Co. ..... *
Baltimore & Ohio Railroad ..... *
Barber Colman Co. ..... *
Beckman Instruments ..... *
Bell & Gossett Co. ..... *
Belmont Packing & Rubber Co. 192
Betz Co., W. H. & L. D. ..... *
Biddle Co., James G. 178
B-I-F Industries, Inc. 223
Bigelow Co. 210
Bin-Dicator Co. ..... *
Black, Sivalls & Bryson, Inc. ..... *
Blaw-Knox Company ..... *
Boiler Tube Co. of America 224
Bonney Forge & Tool Works 234
Bridgeport Brass Co. 233
Bros Boiler & Mfg. Co., Wm. 42
Buell Engineering Co. 182
Buffalo Forge Co. 167
Buffalo Pumps, Inc. 242
Builders-Providence, Inc. 223
Bussmann Mfg. Co. ..... *
Byron Jackson Div., Borg-Warner Corp. 183

Carey Mfg. Co., Philip ..... Back Cover
Cash Co., A. W. ..... *
Catawissa Valve & Fittings Co. 232
Celanese Corp. of America (Chemical Div.) 143
Chapman Valve Mfg. Co. 216
Chase Brass & Copper Co. ..... *
Chesapeake & Ohio Railway 48
Chesterton Co., A. W. 226
Chicago Pneumatic Tool Co. 16-17
Childers Mfg. Co. ..... *
Cities Service Oil Co. 179
Clarage Fan Co. 37
Clark Bros. Co. ..... *
Cleaver Brooks Co. (Boiler Div.) ..... *
Cleveland Fuel Equipment Co. ..... *
Cleveland Vibrator Co. 252
Cochrane Corporation 68
Coffin, Jr. Co., J. S. ..... *
Combustion Control Div., Electronics Corp. of America ..... *
Combustion Engineering, Inc. 20-21
Condenser Service & Engrg. Co. 194
Cooper-Bessemer Corp. 38
Copes-Vulcan Div., Continental Foundry & Mach. Co. ..... *
Coppus Engineering Corp. 65
Corning Glass Works 213
Crane Company 161
Crane Packing Company 174
Crawford Fitting Co. 228
Cyclotherm Div., National-U.S. Radiator Corp. 218

Dage Television Div. ..... *
Darling Valve & Mfg. Co. ..... *
Deady Chemical Co. ..... *
Dearborn Chemical Co. 33
DeLaval Separator Co. ..... *
DeLaval Steam Turbine Co. 2
Deming Company 238
Detroit Stoker Co. 195
Diamond Power Specialty Co. 8-9, 181
Dodge Mfg. Corp. 204, 205
Dow Corning Corp. 168

Dowell, Inc. 173
Dravo Corporation ..... *
Drew & Co., E. F. ..... *

Eagle-Picher Co. ..... *
Edison Inc., Thomas A. 230
Edward Valves, Inc. 28-29
Electric Machy. Mfg. Co. 139
Elgin Softener Corp. 188
Elliott Company 200
Engineer Company 244
Enos Coal Mining Co. 232
Erico Products, Inc. ..... *
Erie City Iron Works 26-27
Ernst Water Column & Gage Co. 244, 256
Everlasting Valve Co. ..... *

Farr Company ..... *
Felt Products Mfg. Co. ..... *
Fisher Governor Co. ..... *
Flexitallic Gasket Co. 141
Foster Engineering Co. 240
Foster Wheeler Corp. 10-11, 159
Foxboro Company 108
Frick Company ..... *
Friez Instrument Div. Bendix Aviation Corp. 196
Fuller Company ..... *

Garlock Packing Company 186
General Blower Co. 252
General Cable Corp. ..... *
General Electric Co. (Apparatus Dept.) 41, 206-207
General Precision Equip. Corp. ..... *
General Refractories Co. 47
Goodrich Co., B. F. 266
Goulds Pumps, Inc. 176
Graver Water Conditioning Co. ..... *
Green Fire Brick Co., A. P. ..... *
Green Fuel Economizer Co. ..... *
Greene, Tweed & Co. ..... *
Grinnell Company ..... Third Cover
Griscom-Russell Co. ..... *
Gulf Oil Corp. ..... *
Gustin-Bacon Mfg. Co. ..... *

Hagan Corporation 208-209
Hall Laboratories ..... *
Harbison Walker Refractories Co. ..... *
Haskins-Turner Co. ..... *
Hays Corporation ..... *
Hewitt-Robins, Inc. ..... *
Heyl & Patterson, Inc. ..... *
Hill Pump Valve Co. 256
Hoffman Specialty Mfg. Corp. ..... *

I-T-E Circuit Breaker Co. Switchgear Div. ..... *
Illinois Water Treatment Co. ..... *
Infilco Inc. 62
Ingersoll-Rand Co. 45
International Nickel Co., Inc. ..... *
Iron Fireman Mfg. Co. ..... *

Jeffrey Mfg. Co. 227
Jenkins Bros. 150-151
Jerguson Gage & Valve Co. ..... *
Johns-Manville 157
Johnson Service Co. 39
Joy Mfg. Company 247

Kaiser Company, E. B. 237
Kaiser Engineers, Div. of Henry J. Kaiser Co. ..... *
Keasbey & Mattison Co. 203
Keeler Company, E. ..... *
Kennedy-Van Saun Mfg. & Engrg. Co. 70-71
Kewanee-Ross Corp. ..... *
Key Company ..... *
Klinger, Ltd., Richard ..... *
Klipfel Valves, Inc. ..... *
Koppers Co., Inc. (Aeromaster Fans) 184
Koppers Co., Inc. (Coupling Dept.) 175
Koppers Co., Inc. (Piston Ring & Seal Dept.) 229
Kuljian Corporation 180

Laclede Stoker Co. ..... *
Ladish Co. 34-35
Layne & Bowler Pump Co. ..... *
Leeds & Northrup Co. 66
LeRoi Division, Westinghouse Air Brake Co. 63
Leslie Company ..... *
LimiTorque Corp. 191
Link-Belt Company 1
Lockett & Co., Ltd., A. M. 224
Lunkenheimer Company 147

Manning, Maxwell & Moore, Inc. ..... *
Marley Company ..... *
Marsh Instrument Co. 36
Mason-Neilan Regulator Co. ..... *
McDonnell & Miller, Inc. ..... *
McGraw-Hill Book Co. 246
McKiernan-Terry Corp. ..... *
Mesta Machine Co. ..... *
Metal & Thermit Corp. ..... *
Midcontinent Tube Service, Inc. 256
Midwest Piping Co., Inc. 49
Mine Safety Appliances Co. 228
Minneapolis-Honeywell Reg. Co. Industrial Div. 22-23
Murray Iron Works Co. 55, 248
Murray Mfg. Co., D. J. ..... *

National Airoil Burner Co., Inc. 198
National Aluminate Corp. 149
National Coal Association 249
National Tube Div. ..... *
National Valve & Mfg. Co. 155
Niagara Blower Co. ..... *
Nicholson & Co., W. H. 211
Nordberg Mfg. Co. ..... *
North American Mogul Products Co. ..... *
Norton Company ..... *

Ohio Brass Co. 61
Ohio Injector Co. ..... *
Okonite Co. 60
Orr & Sembower, Inc. 201
Owens-Corning Fiberglas Corp. ..... *

Pacific Pumps, Inc. ..... *
Pantex Manufacturing Corp. ..... *
Peabody Engineering Corp. ..... *
Pennsylvania Crusher Div. 169
Pennsylvania Flexible Metallic Tubing Co., Inc. ..... *
Permutit Company 59
Perolin Co., Inc. ..... *
Petro ..... *
Philadelphia Gear Works 191
Phoenix Mfg. Co. (Flange Div.) 265
Pipe Fabrication Institute 177
Pittsburgh Piping & Equipment Co. 199
Powell Co., Wm. 197
Powers Regulator Co. 133
Pratt Co., Henry ..... *
Pritchard & Co., J. F. 212, 213
Proportioneers, Inc. ..... *
Pure Oil Company ..... *

Raybestos-Manhattan, Inc. Manhattan Rubber Div. 243
Raybestos-Manhattan, Inc. Packing Div. 250
Refractory & Insulation Corp. ..... *
Republic Flow Meters Co. 30-31
Republic Steel Corp. ..... *
Research-Cottrell, Inc. 58
Revere Copper & Brass, Inc. 165
Ric-Wil Incorporated 57
Ridge Tool Co. 222
Riley Stoker Corporation 106-107
Rohm & Haas Co. (Resinous Prod. Div.) ..... *
Roto Div. of Elliott Co. ..... *

Sarco Company 153
Schaub Engrg. Co., Fred H. 231
Scovill Mfg. Co. ..... *
Sinclair Refining Co. ..... *
Smith Company, S. Morgan 225
Smith Corporation, A. O. 24-25
Socony Mobil Oil Co., Inc. ..... *
Solar Aircraft Co. 44
Spence Engineering Co. 219
Springfield Boiler Co. 187
Squires Co., C. E. ..... *
Standard Oil Co. of Indiana 163

"Nuclear Energy Today"

A POWER special report. 24 pages, generously illustrated, giving you the latest word on one of the fastest-changing and most challenging power developments.

Extra copies of this report now available at 60¢ each. Slightly less when ordered in quantities.

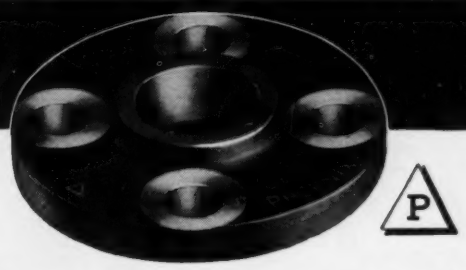
WRITE TO

POWER

Reader Service Dept.
330 West 42nd St.
New York 36, N.Y.

PHOENIX *Drop-Forged* FLANGES MEAN...

MAXIMUM STRENGTH



Long life is assured with Phoenix maximum strength flanges. Forged of mild steel, they are available in a wide range of styles and sizes. Meet ASA requirements and ASME and ASTM specifications.

NEW CATALOG!
Send for free brochure showing Phoenix Complete Line.

FLANGE DIVISION
PHOENIX MANUFACTURING CO.
Catasauqua, Pa. • Joliet, Ill.

Stephens-Adamson Mfg. Co. 255
Stickle Steam Specialties Co. 246
Stock Equipment Co. ..... *
Stone & Webster Engrg. Co. ..... *
Strong, Carlisle & Hammond Co. ..... *

Taylor Instrument Co's 46
Taylor & Co., W. A. ..... *
Tempil Corp. ..... *
Tennessee Corporation ..... *
Terry Steam Turbine Co. 189
Texas Company 4
Thermal Research & Engrg. Corp. ..... *
Toledo Pipe Threading Machine Co. ..... *
Tube Turns, Inc. ..... *

Union Asbestos & Rubber Co. ..... *
Union Iron Works 235
United States Gasket Co. 192
United States Rubber Co. (Mechanical Goods Div.) 50
United States Steel Corp. 64
Universal Atlas Cement Co. 253

Van Der Horst Corp. ..... *
Viking Pump Co. 236
Vogt Machine Co., Henry 53

Wallace & Tiernan Inc. ..... *
Walworth Company 72
Warren Steam Pump Co., Inc. ..... *
Watson-Stillman Fittings Div. ..... *
Western Chemical Co. 214
Westinghouse Electric Corp. ..... *
Westinghouse Electric Corp. (Sturtevant Div.) 202
Wheeler Mfg. Co., C. H. ..... *
Where to Buy 256
Wickes Boiler Co. 40
Wiedeke Co., Gustav ..... *
Wiegand Co., Edwin L. (Ind. Div.) ..... *
Wilson, Inc., Thomas C. 241
Wing Mfg. Co., L. J. 190
Worthington Corporation ..... *
Wright-Austin Co. ..... *

Yarnall-Waring Company 18-19, 135
Youngstown Sheet & Tube Co. 215

Zallea Bros. 185

Professional Services **256**

CLASSIFIED ADVERTISING

F. J. EBERLE, Ass't. Mgr.

EMPLOYMENT OPPORTUNITIES 257-258

EDUCATIONAL 258

EQUIPMENT
(Used or Surplus New)
For Sale 258-263

WANTED
Equipment 258

ADVERTISERS' INDEX
American Air Compressor Corp. 263
Atlantic Transformer Co. 262
Belyea Co., Inc. 261
Benson-Wilimzig Inc. 260
Boston Metals Co., Inc. 260, 262
Chicago Electric Co. 260
Darien 262
DeRose, G. M. 260
Ebasco Services Inc. 262
Electric Equipment Co. 261
Electric Service Co., Inc. 260
Eljay Inc. 258
General Electric Co. 257
Hall & Co., Stephen 263
Harris Machinery Co. 263
Heat & Power Co., Inc. 263
Hemphill & Co., Inc. 262
Howe Brothers 262
International Power Machinery Co. 262
Jergens Co., Andrew 260
Land, L. J. 260
Lefax 258
McKee Co., Arthur G. 257
Neu Corp., Hugo 262
Oberman, Paul 258
Philadelphia Transformer Co. 262
Power Plant Equipment Co., Inc. 258
Schoonmaker Co., Inc., A. G. 263
Sorenson Governor Service 263
Soul Clinic Inc. 258
Turner, W. D. 258
Wagner Co., Arthur 261
Weaver, Charles 259, 262
Woodstock, Illinois Power & Light 258

RESEARCH KEEPS **B.F.Goodrich** FIRST IN RUBBER

TVA's Shawnee Steam Plant

It takes coal on a ½-mile flight

A typical example of B. F. Goodrich improvement in rubber

HERE'S where electric power is made for an atomic energy project in Kentucky. A network of nearly 3 miles of B. F. Goodrich conveyor belts, going in 4 directions at once, keeps coal flowing into the plant. They carry 1400 tons an hour. One belt goes over towers 50 feet high, over a road and a river channel; some climb steep grades; others tunnel underground.

Getting the coal from river barges to the plant—a half mile away—was a special problem. B. F. Goodrich engineers knew that an ordinary belt, of rubber and fabric, couldn't handle the heavy loads, at this distance. So they recommended a B. F. Goodrich *cord* belt. It's made with cords, running lengthwise, held in place by rubber. The tough cords add strength and load-carrying power, so a single belt can travel distances once considered impossible.

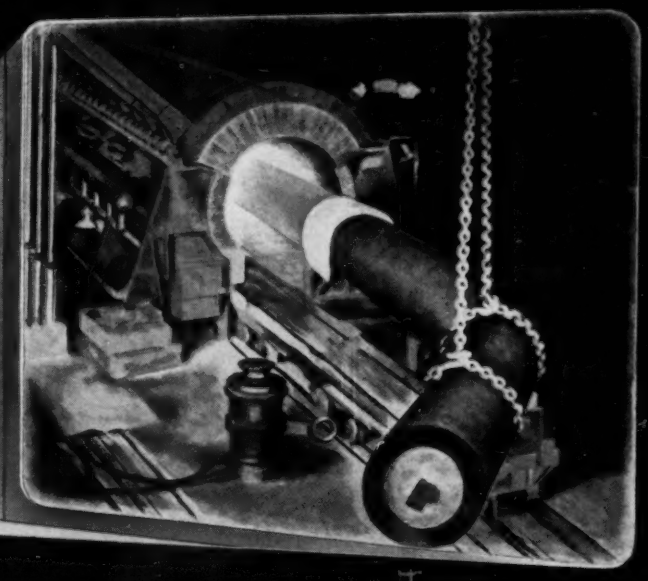
The cords make it a more flexible belt, so it troughs perfectly whether fully loaded or running empty. The cord belt lasts longer, too. It has 2 to 6 times the impact resistance of a rubber-and-fabric belt. This means it can take crashing blows that would cut, gouge and break an ordinary belt. And cords-sealed-in-rubber, plus special chemicals, give the belt double protection against mildew and rot.

B. F. Goodrich cord belts nearly always outlast other types on tough jobs where severe operating conditions call for the best and most modern belt construction. Let your B. F. Goodrich distributor show you how this longer belt life, this ability to stand harder use, can reduce your belting costs per year, make other savings in operating and maintenance costs. *The B. F. Goodrich Co., Dept. M-526, Akron 18, Ohio.*

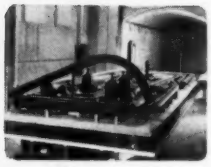
B.F.Goodrich
INDUSTRIAL PRODUCTS DIVISION

Available to Company Groups and Technical Associations

INFORMATIVE!
INTERESTING!



Bending



Stress Relieving

Automatic Welding

Ultrasonic Testing

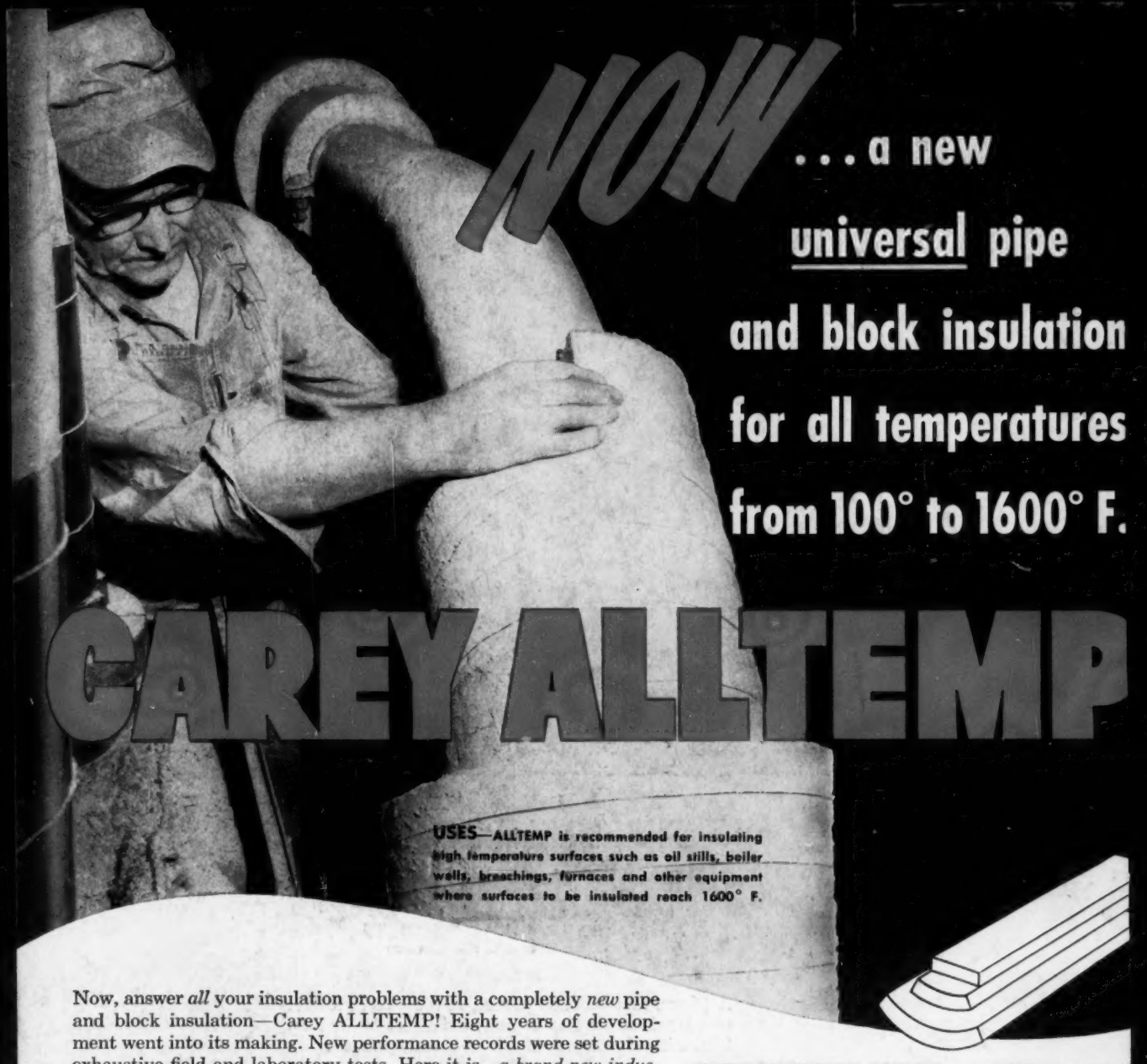
"PREFABRICATED PIPING by GRINNELL"

A 16mm. sound motion picture, in full color. Provides an educational close-up of latest techniques in the shop fabrication of piping. Available for showing without cost.

"Prefabricated Piping by Grinnell" is a fascinating and factual film. Produced by the 100-year old Grinnell Company, it sheds new light on the complex subject of prefabrication of piping . . . answers with complete authority many of the questions dealing with shop vs. field fabrication.

Now you can see for yourself how the experts bend 20-inch pipe, with walls four inches thick; how pipe is sand-packed to prevent collapse in bending; how alloy pipe is pre-heated to preserve its special characteristics; how to stress-relieve after bending or welding; how to cold bend pipe; extrude branch outlets; perform automatic welding. You can look over the shoulders of the experts . . . during radiographic inspection, hydrostatic testing, and photomicrographic examination.

There is no charge for this film. Engineering societies and engineering departments that desire to show this picture should address their local Grinnell Supply Sales Office, or Publicity Department, Grinnell Company, Inc., 278 West Exchange St., Providence, R. I. Requests will receive prompt attention.



NOW . . . a new universal pipe and block insulation for all temperatures from 100° to 1600° F.

CAREY ALLTEMP

USES—ALLTEMP is recommended for insulating high temperature surfaces such as oil stills, boiler walls, breachings, furnaces and other equipment where surfaces to be insulated reach 1600° F.

Now, answer *all* your insulation problems with a completely *new* pipe and block insulation—Carey ALLTEMP! Eight years of development went into its making. New performance records were set during exhaustive field and laboratory tests. Here it is—*a brand-new industrial insulation* for all temperatures up to 1600° F.

ALLTEMP keeps every last BTU on the job producing power. Its extremely low percentage of shrinkage—approximately ⅔ *less* than other 1200° F. insulation materials—means joints won't open, cracks won't appear in covering. BTU's are *locked in!* ALLTEMP retains its high thermal efficiency and structural strength even after long, continuous exposure to excessive heat and moisture. Non-brittle, it resists blows, abrasions; won't crack or crumble under severe service conditions. And it's easy on the hands—easy to cut, fit, install!

Get all the cost-saving facts on new ALLTEMP today and your copy of the Carey ALLTEMP specification folder.
Just address coupon below.

ALLTEMP RECOMMENDED THICKNESS

Nominal Pipe Size Inches	Temperature Difference °F 80° Air					
	200	400	600	800	1000	1200
	Nominal Thickness, Inches					
1½ & Under	1	1	1½	2	2½	3
2	1	1½	2	2½	2½	3
2½	1	1½	2	2½	3	3½
3	1	1½	2	3	3	3½
3½	1	1½	2	3	3½	3½
4	1	1½	2½	3	3½	4
4½	1½	2	2½	3	3½	4
5	1½	2	2½	3	3½	4
6	1½	2	2½	3½	4	4½
7	1½	2	2½	3½	4	4½
8	1½	2	3	3½	4	4½
9	1½	2	3	3½	4½	5
10	1½	2½	3	4	4½	5
11	1½	2½	3	4	4½	5
12	1½	2½	3	4	4½	5
14 & Over	1½	2½	3½	4	4½	5½

ALLTEMP is available in clean, easy-to-handle flat and preformed blocks. "Nesting" O.D. pipe covering sizes provide accurate, tight fits for multiple layer construction. Only a limited number of "prime" units are necessary for unusual assemblies.

Better Products for Industry Since 1873

Carey

THE PHILIP CAREY MFG. COMPANY
Lockland, Cincinnati 15, Ohio
In Canada: The Philip Carey Co., Ltd., Montreal 3, P.Q.

Carey-approved contract units in major trading areas. Consult your nearest Carey District Office or your Telephone directory.

FREE FOLDER

THE PHILIP CAREY MFG. COMPANY
Lockland, Cincinnati 15, Ohio • Dept. P-1

Please send free illustrated folder showing specifications, installation details and complete facts on new ALLTEMP insulation.

☐ Have your Industrial Sales Engineer call without obligation.

NAME_____

COMPANY_____

ADDRESS_____

CITY_____ ZONE____ STATE_____